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UNITED STATES

DEPARTMENT OF THE INTERIOR

FINAL
ENVIRONMENTAL STATEMENT
Volume 2 of 5

Proposed
1975 OUTER CONTINENTAL SHELF OIL AND GAS GENERAL LEASE SALE OFFSHORE SOUTHERN CALIFORNIA

(O.C.S. Sale No. 35)

Prepared by the

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III. Environmental Impact of the Proposed Sale

A. General Environmental Impacts of Offshore Oil and Gas Operations

The development and production activity following this potential sale could result in a variety of impacts on the natural environment, Channel Island area resources, air and water quality, land use patterns, the social order and the economy. The intent of this section is to illustrate how routine operation and occasional accidents can result in situations leading to human and natural environmental impacts. Included are statistics, and where possible, examples and case histories of impacts caused by incidents and by day-to-day operations considered "unavoidable" in light of existing regulations, technology and operating practices.

1. Impacts Resulting form Day-to-Day Operations Which are Unavoidable Under Existing Operating Practices, Regulations, Economics and Technology

a. Discharge of Drilling Mud and Drill Cuttings

A development well assumed to be completed on the ocean floor in 1000 feet of water and with normal pressures, (i.e., the pressure gradient does not exceed 0.465 psi per foot of depth), using a drill ship to drill the well, and with the rig floor 30 feet above sea level, would have 5 casing strings as follows:

- 30 inch structural casing set at a minimum depth of 100 feet below the sea floor.
- 20 inch conductor set at 500 feet of penetration into the sea floor (1500 feet from rig floor).
- 13-3/8 inch surface set at 1500 feet of penetration (2500 feet from rig floor).
- 9-5/8 inch intermediate set at 3500 feet of penetration (4500 feet from rig floor).
- 7 inch production casing set at 9,000 feet of penetration (10,000 feet from rig floor).

This assumed 9,000 foot well in 1000 feet of water will generate almost 1300 barrels of cuttings weighing about 540 tons. Table III-1 shows the approximate volume and weights of cuttings generated by drilling each section of hole.

A 36 inch hole is drilled to a minimum depth of 100 feet below the sea floor.

Sea water is used to drill this section of hole and the drilled cuttings are circulated out on the sea floor. A light sea water gel mud is spotted in the 36 inch hole to keep it open while the 30 inch casing

TABLE III - 1

VOLUME OF CUTTINGS GENERATED AND DRILLING MUD USED

for a TYPICAL WELL IN 1000' of WATER

Interval Feet (Rig Floor)	Sea Floor Penetration	Hole Size	Casing Size	Volume of Cuttings Bbls.	Approx. Wt. of Cuttings	Drilling Mud
1000 - 1100	100	36"	30"	125	104,500	Sea Water
1100 - 1500	500	26"	20"	262	219,000	Sea Water
1500 - 2500	1500	17-$\frac{1}{2}$"	13-3/8"	297	248,300	Natural Sea Water Mud
2500 - 4500	3500	12-$\frac{1}{4}$"	9-5/8"	291	243,300	Gelled sea water
4500 - 9000	8000	8-$\frac{1}{2}$"	7"	315	264,000	Lignosulfonate
			TOTAL	1290	1,079,100	

and permanent landing base is run. The 30 inch casing is cemented back to the sea floor.

A 26 inch hole is drilled to 500 feet below the sea floor. Sea water is used to drill this section of hole with the drilled cuttings being circulated out on the sea floor. A light sea water gel mud is spotted to hold the hole open while the 20 inch casing is being run. The 20 inch casing is cemented back to the sea floor.

A 17-1/2 inch hole is drilled below the 20 inch casing to 1500 feet below the sea floor. Sea water is used to drill this section of hole from 500 to 1500 feet below the sea floor. In most areas there are enough clays being drilled to make a natural mud. If the clays are not present in sufficient quantities it may be necessary to add some salt water gel (attapulgite clay) to the system to keep the hole open. The mud weight is maintained at 9.0± lbs. per gallon.

The cuttings are screened from the mud by use of a shale shaker and are returned to the sea. Any excess natural mud is also discharged in the sea.

The 13-3/8 inch casing is run to 1500 feet below the sea floor and cemented back to the sea floor.

A natural sea water mud with some salt water gel added is used to drill the 12-1/4 inch hole from 1500 to 3500 feet below the sea floor. The mud weight will be about 9.2-9.5 lbs. per gallon. The cuttings are separated from the mud with a shale shaker and returned to the ocean. Any excess mud is discharged into the ocean.

The 9-5/8 inch casing is set at 3500 feet below the sea floor. The fracture gradient at 3500 feet penetration is equivalent to 12.2 lbs. per gallon (91.3 lbs. per cu. ft.) mud. The mud weights used below the 9-5/8 inch casing cannot exceed 12.2 lbs. per gallon unless another string of casing is run to a deeper depth.

An 8-1/2 inch hole is drilled below the 9-5/8 inch casing to a total depth of 9,000 feet (1000 feet of penetration). 7 inch casing is set at 9,000 feet. The mud weights used to drill this section of hole will range from 10.0 to 10.5 lbs. per gallon (75 to 78 lbs. per cu. ft.). The mud used will be a lignosulfonate mud.

The typical composition of lignosulfonate mud of 10.5 lbs. per gallon is as follows:

Weight Per Bbl	Mud material
10-12 lbs.	Bentonite clay
120 lbs.	Barium sulfate (Barite)
1 lb.	Sodium hydroxide (Caustic)
6-8 lbs.	Sodium lignosulfonate
0.5-1 lb.	Organic Polymer
0.1-0.25	Defoaming agent
85%	Water

Drilling muds are not normally dumped into the ocean in large quantities. It is forbidden by OCS Order No. 7 to dump drilling mud containing oil into the ocean. This OCS order also forbids the discharging, into the ocean, of drilling mud that has been treated with chemicals of a type or quantity that would result in the drilling mud being toxic and thus detrimental to the marine environment.

Of some concern is the presence of chromium in some marine drilling muds as the organic complex, (ferro)chrome lignosulfonate. Overboard loss or discharge of drilling fluids would introduce some of this chromium into the marine environment. Overall recent industry tendencies toward maximum recovery of chemical additives minimize any potential hazard to marine life.

The use of chrome materials, oil and other toxic materials in Pacific offshore mud systems has been avoided for several years. Sodium lignosulfonate has replaced ferrochrome lignosulfonate in a majority of Pacific offshore mud systems. Barium sulfate (barite) and chromium lignosulfonate are commonly used compounds found in offshore drilling mud programs in the Gulf of Mexico OCS.

Barite is used as a weighting agent to control formation pressures while drilling in the mid to bottom portions of the hole. Chromium lignosulfonates are thinners which are placed into a mud system for control of viscosity, gel strength, and filtrate loss. They are also introduced into the mud system while drilling from the mid to bottom portions of the hole. There is strong environmental concern about products containing barium and chromium due to the possibility of the release into the environment of the toxic Ba^{+2} and hexavalent Cr^{+6} ions.

Barite has been used in Gulf of Mexico drilling mud programs since the inception of drilling in 1947. The data from several investigations have shown barite to be essentially non-toxic to marine organisms. The threshold LC_{50} of the barite was found to be greater than 7500 ppm. The concern that the Ba^{+2} ion will be released from barite seems to be unfounded. Barium sulfate has a very low solubility ranging from .000246 to .000413 gms/100cc of fresh water. Also, barium sulfate is a non-toxic insoluble salt that is used as an opaque medium in radiography. Investigative results and the physical properties of barium sulfate classify it as a low to non-toxic compound. As long as barium remains in compounds having very low solubilities, it is non-toxic. If alteration to soluble forms occurs under certain circumstances in the marine environment, toxicity could be a problem. Presently, the existence or non-existence of such alteration mechanisms is not known.

The modified lignosulfonates (chromium and ferrochromium) are prepared by the dichromate oxidation of sulfite pulp lignosulfonate liquor. This reaction firmly chelates the chromium so that it may not be removed from the lignosulfonates complex even by strong ion-exchange resins. Further studies show the chromium ion to be in a trivalent state which may interact with the planar surface of bentonite clays by a base-exchange mechanism. These results would indicate that the trivalent chromium ion added to the drilling mud, in the form of a modified lignosulfonate, is either strongly associated with the lignosulfonate or bentonite clay and as such does not enter into additional reactions. The Gulf Universities Research Consortium (GURC) reported that concentrations of trace and toxic metals (barium and chromium) present no evidence of biological hazard and are below levels promulgated as being harmful to living things. The values reported for chromium from the Offshore Ecology Investigation data are within the ranges reported for other oceanic waters.

Bioassay studies have shown chrome-lignosulfonate to have a 96 hr TLm in salt water of 12,200 ppm and a 96 hr TL_{50} of 465 ppm. In a study of drilling fluids used in the Canadian Arctic a concentration gradient of Cr in undiluted mud discharges ranged from .3 ppm at the top of the hole to 24.8 ppm at TD. Once on the seafloor, chrome-lignosulfonate is fairly resistant to biodegradation, however, certain benthic invertebrates are known to concentrate trace amounts, of various heavy metals over extended time. The possible role of drilling mud chromium additives in this phenomenon is the subject of ongoing research.

To drill the 9,000 foot (subsea) well described above would require some 1600 barrels of drilling fluid in the system at total depth.

Using the range of wells assumed to be required (section I.D.) of 860-5455 and assuming all are drilled to 8,000 feet of seafloor penetration, a total of between 1.1 and 70 million barrels of drill cuttings weighing between 0.5 and 3.0 million tons would be discharged into the sea. If it is further assumed that each well discharges 200 barrels of drilling mud into the water (due to conditioning the system to maintain proper safe and desirable characteristics) and each of the 14-60 platforms jettisons one complete mud system, then between 14,000 and 84,000 tons of mud additives would be dumped (between 12,000 and 71,000 tons of this would be the insoluble barium sulfate (barite) weighting material). This is a "worst-case" example because it assumes all tracts will be leased and because in actual practice very few complete mud systems are discharged overboard--mainly for economic reasons. Table III-2 shows some typical mud components which may find their way into the marine environment.

Table III-2 COMPONENTS OF DRILLING MUDS WHICH MAY BE DISCHARGED INTO THE SEA

Substance	Source	Use	Composition	Known Hazard
Attapulgite clay	Quarry	To cause gelling of salt water based muds	A light green magnesium-rich clay, quarried as "Fullers Earth"	NONE
Bentonite Clay	Quarry	To cause gelling of freshwater based muds	A light-colored montmorillonitic clay; slippery sticky when wet; swells to 10-20 times its dry volume	NONE
Caustic soda	Electrolysis of sodium chloride brine	For pH control	Sodium hydroxide, NaOH	Corrosive in concentrated form; not harmful after mixing into mud at low concentration and allowed to react
Barite	mined as the mineral	weighting agent	Barium Sulfate $BaSO_4$	It is recommended that public water supplies contain no more than 1 mg/l barium.
Organic polymer	Chemical process with plant starch, wood fiber as raw materials	Conditioner, texturizer	Starch, cellulosic derivatives	NONE
Proprietary defoamer	Soap making process	Defoamer	Aluminum stearate $\mathrm{Al\underline{/}\overline{C}h_3(CH_2)1\underline{6}/3}$	NONE

Occasionally, abnormal formation pressures, exceptionally tight formations, or other problems require the use of oil-base mud or highly treated drilling muds. Drill cuttings are then separated and cleaned of entrained oil before being discharged overboard, and the drilling muds are retained and shipped to shore and stored in tanks for future use.

A typical 9000-foot platform well would generate approximately 1,300 barrels of cuttings weighing almost 1,080,000 pounds. (See Table III-1.) The cuttings would normally be released from a vertical outfall pipe about 100 feet below the water surface. Immediately below a 30-well platform drill cuttings could produce a mound approximately 80 to 100 feet in diameter and 20 feet in height, in which grain size might differ from that of surrounding sediments. The finer-grained portions of the cuttings would be expected to be distributed by prevailing currents over a much larger area and would grade into the natural sediments. A reasonable estimate of the range of possible total affected area would be from about 1/5 acre to about 2 acres.

The effects of cuttings deposition would be limited to the following:

- Smothering of the less motile representatives of the benthic epi- and infauna (occlusion of feeding mechanisms of filter and suspension feeders, and asphyxiation attending burial). This would include burial of encrusting epifauna on portions of the platform near the ocean floor. The effect would be to reduce the food available to animals at higher trophic levels. As the affected area would be so limited, cuttings deposition is not likely to be of measurable significance to fish populations.

- Temporary increase in water turbidity, reducing the amount of light available for plant (mainly plankton) photosynthesis. The area, periods of turbidity, and portion of local plant populations involved would be very small, especially since the depth of outfall pipes would normally be well below the photosynthetic zone.

- Possible impedance of recolonization in the cuttings mounds if sediment texture contrasts with local sediments. This effect, if it exists, might be temporary if deposition of a substantial layer of natural sediments occurs subsequent to drilling operations.

Studies by the California Department of Fish and Game indicated that deposition of washed drill cuttings on the bottom beneath Standard-Humble Oil Platform Hazel neither added anything favorable nor greatly detracted from the character of the environment (Fish Bulletin 124). Extent of recolonization of cuttings mounds by benthic epi- and infauna is not known.

b. Discharge of Produced Formation Water

USGS (letter 13 June 1974) estimates that the proposed sale area would yield 1.5 billion barrels of formation water during its lifetime. The offshore Santa Barbara Channel, Dos Cuadros and Carpenteria fields yield 33,650 barrels per day (167 wells). Wells in initial stages of development may have formation waters which represent 20-30% of the total extractable fluid. As the oil reservoir is depleted the ratio of formation water to oil produced increases. The average ratio of water to oil may be approximately one to one. The maximum amount of formation water produced during the life of oil production will be approximately 2-3 barrels of formation water per barrel of oil produced (EPA, 1974). Present daily formation water and oil production from OCS platforms in the Santa Barbara Channel are shown in the following table.

Current Santa Barbara Oil Production and
Formation Water Production Per Day

Platform		Barrels Oil Produced	Barrels Formation Water Produced
A	(4-29-75)	14,817	14,629
B	(4-30-75)	12,351	14,267
Hillhouse	(4-28-75)	10,349	4,992
Houchin	(4-24-75)	4,893	9,880
Hogan	(5- 1-75)	5,018	9,360

Within the proposed lease area, oil production could be 1.6 - 14.0 billion barrels of oil. This would be extracted over a forty year period.

The expected daily production of oil will be from 4.6 - 40 million gallons per day. Considering the average amount of formation water production per day over the life of the field, we can anticipate 4.6 - 40 million gallons of formation water produced per day. On any one day the low to high ranges would be 0.92 - 8.00 to 13.80 - 120 million gallons per day, respectively.

Depending upon which formation the oil field is in contact with, dissolved elements and their respective concentrations will change. Some fields in Texas produce almost pure water, whereas a Michigan field produced brines containing 624,798 ppm mineral salts. Based on a relatively small amount of data, the oil field brines of the California coastal region range from about 26,000 parts per million (ppm) to 40,400 ppm mineral salts. Oil field brines commonly contain varying amounts of iron, calcium, magnesium, sodium, bicarbonates, sulphate, and chloride ions. For informative purposes, Table III-3, which shows the content of three representative brines (formation water) from offshore Louisiana, is included below. They are classed as formation waters containing (1) high solids, (2) average solids, (3) low solids. Table III-4 summarizes the type of treated effluent produced by Dos Cuadros field wells offshore California, which falls below the low concentrations of components in Table III-3.

Table III-3 CHEMICAL CONTENT OF REPRESENTATIVE OFFSHORE BRINES 1/

Offshore Louisiana

Component		High Solids		Average Solids		Low Solids	
		mg/1 2/	%	mg/1	%	mg/1	%
Iron	Fe	153	0.057	15	0.011	139	0.226
Calcium	Ca	17,000	6.287	4,675	3.294	772	1.254
Magnesium	Mg	2,090	0.773	1,030	0.726	152	0.247
Sodium	Na^+	84,500	31.250	49,120	34.612	22,651	36.800
Bicarbonate	HCO_3^-	37	0.014	100	0.070	933	1.516
Sulfate	$SO_4^=$	120	0.044	0	0	188	0.305
Chloride	Cl^-	166,500	61.575	86,975	61.287	36,717	59.652
Total Solids		270,400	100%	141,915	100%	61,552	100%

1/ From U. S. Geological Survey, Oil and Gas Supervisor, Gulf of Mexico Area. New Orleans, Louisiana.

2/ mg/1 is equivalent to part per million.

Table III-4
Phillips Petroleum Company
OCS P-0166 Lease - La Conchita Plant
Typical Characteristics of Effluent from Water Treatment Facilities

Physical Properties	
pH	7.3
Specific Gravity	1.02
Turbidity	12 JTU
Total Dissolved Solids (Calc.)	40,400 mg/1
Total Solids	20,990 mg/1
Total Volatile Solids	1810 mg/1
Total Suspended Solids	56 mg/1
Settleable Solids	0.1 mg/1
Floatable Solids	0.3 mg/1
Temperature	77°F
BOD, 5-day	450 mg/1
COD	691 mg/1
Specific Conductance	31,630 m-mhos/cm
Max. $CaSO_4$ Possible (Calc.)	0. mg/1
Max. $BaSO_4$ Possible (Calc.)	0. mg/1
Alkalinity as $CaCO_3$	3480 mg/1
Dissolved Solids	
Cations	
Total Hardness	10 me/1
Sodium, Na^+ (Calc.)	15,000 mg/1
Calcium, Ca^{++}	80 mg/1
Magnesium, Mg^{++}	72 mg/1
Iron (Total), Fe^{+++}	1.0 mg/1
Anions	
Chloride, Cl^-	21,000 mg/1
Sulfate, $SO_4^=$	0. mg/1
Carbonate, $CO_3^=$	0. mg/1
Bicarbonate, HCO_3^-	4,270 mg/1
Hydroxyl, OH^-	0. mg/1
Sulfide, $S^=$	1.1 mg/1
Dissolved Gases	
H_2S	0.4 mg/1
CO_2	320 mg/1
O_2	0.3 mg/1

Chemical Properties, mg/1		
Aluminum		2.2
Ammonia, N		39.7
Arsenic		0.001
Barium		0.
Bromide		183.8
Cadmium		0.030
Chromium		0.020
Copper		0.116
Cyanide		0.004
Fluoride		1.7
Iron		1.35
Lead		0.28
Magnesium		50.0
Manganese		0.062
Mercury		0.0005
Nickel		0.29
Nitrate, N		0.0
Nitrate, N		0.000
Kjeldahl Nitrogene		54.6
Phosphorus-Ortho, P		1.54
Phosphorus, P		1.89
Silver		0.030
Zinc		0.18
Phenolic Compounds $C_6 11_5 011$		2.10
Identifiable Chlorinated Hydrocarbons		None
Radioactivity		
Gross Alpha Activity	None Detected	
Gross Beta Activity	None Detected	
Oil and Grease		5.0

Table III-5 gives a range of constituents in produced formation water for offshore California. Within Table III-5 are the State of California Ocean Effluent Limits.

In addition to water quality degradation from high mineral content and low dissolved oxygen, a very small amount of oil is entrained in formation waters which are discharged into the sea. OCS operating orders require that the average oil content at the point of discharge must not average more than 50 ppm. EPA is presently developing effluent limitations for discharges from production platforms which will be based on technological feasibility. OCS operations will be subject to these limitations.

The MIT Offshore Oil Task Group (MIT, 1973) has estimated that biologically, this low concentration, persistent source could be the most significant of all minor discharges, for this oil could contains a high percentage of water soluble aromatics. They note, however, that there appears to be no data on the fractional compositions of the oil remaining in the water after treatment in the oil/water separators. This separation process is ineffective against that portion of the oil which is dissolved in the water.

c. Disposal of Solid Waste and Sewage

USGS (letter 13 June 1974) states that oil free, nontoxic cuttings will be dumped from the platform while contaminated solid wastes will be disposed on shore at an industrial waste site. It is estimated that in drilling an 9,000 foot well, 540 tons of drill cuttings and some muds will be discharged.

TABLE III-5

Range of Constituents in Produced Formation Water -- Offshore California a/ (EPA, 1974)

Effluent Constituent	Range, mg/1	State of California Ocean Effluent Limits b/ mg/1
Arsenic	0.001 - 0.08	0.02
Cadmium	0.02 - 0.18	0.03
Total Chromium	0.02 - 0.04	0.01
Copper	0.05 - 0.116	0.3
Lead	0.0 - 0.28	0.2
Mercury	0.0005-0.002	0.002
Nickel	0.100 - 0.29	0.2
Silver	0.03	0.04
Zinc	0.05 - 3.2	0.5
Cyanide	0.0 - 0.004	0.2
Phenolic Compounds	0.35 - 2.10	1.0
BOD_5	370 - 1,920	
COD	340 - 3,000	
Chlorides	17,230 - 21,000	
Total Dissolved Solids	21,700 - 40,400	
Suspended Solids		
Effluent	1 - 60	
Influent	30 - 75	
Oil and Grease	56 - 359	

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a/ Some data reflect treated waters for reinjection.
b/ Concentrations not to be exceeded more than 10% of time.

Note: We have seen only a small amount of data from offshore wells in California and therefore cannot substantiate this table.

d. Disruption of Sea Floor and Resuspension of Sediments During Pipeline Burial

During pipeline burial, a large volume of sediment is disrupted and resuspended for a short time in the overlying waters. Unfortunately, it is impossible to calculate a reasonably accurate volume of material that is reworked because the width of the trench varies greatly with compactness and the fluidization point of the sediment. A very rough estimate of the trench dimensions is 5 feet deep by 6 to 12 feet wide. Assuming a parabolic cross-section, approximately 4,000-8,000 cubic yards per mile would be disturbed, some of which would be resuspended. This figure cannot be applied to the Geological Survey's prediction of the number of miles of pipeline resulting from this sale because some of that mileage includes sections in water deeper than 250 feet, where burial is not now required; sections of the gathering systems around groups of platforms where burial may not be required; sections in State waters where the Department has no jurisdiction and cannot require burial; sections overlying hard substrates, and sections laid onshore. At some future date, when exact pipeline routes are drawn, this figure may be used as a multiplier to determine the total volume of sediments disturbed. The establishment of pipeline corridors is considered in another section.

e. Digging of Trenches and "Push-Ditches"

The volume of material reworked is of little concern here; instead, the width of upland or wetland disturbed and devegetated is of importance. Our rough estimate is that perhaps a 50 to 60 foot width of land will be extensively driven over by construction equipment and severely disturbed onshore within wetlands or elevated terrain.

f. Placement of Temporary and Permanent Platforms, Boats, Barges, and Pipelines in Conflict with Commercial Fishery Trawling Operations and Ship Navigation

As a result of this sale, as many as 60 platforms may be placed in this area. There are four factors that will affect the commercial fishing in this area. These are (1) the removal of open waters and seafloor from use by purse seiners and trawlers, (2) the creation of obstructions on the seafloor that cause damage to purse seining and trawling nets, (3) the possible contamination of fish by spilled oil, and (4) removal of large areas from fisheries operations during an oil spill.

Ship traffic will increase as a result of this sale which in turn will increase the possibility of ship and platform collisions. Considering the large area involved in this sale as much as 800-900 miles of corridor pipeline may be laid in the proposed area. WOGA estimates 4,000-4,800 miles of total pipeline including oil, gas, and water pipelines. Ship collisions with platforms and ship's anchors dragging across pipelines are discussed in Sec. III.A.2.d. Because of the administrative procedures in water depths under 250 feet, no anchor/pipeline accidents are expected in these waters; however, it should be noted that most of the proposed 297 tracts lie partly or completely beyond the 250-foot contour.

g. Placement of Structures, Pipeline Burial Cuts, and Ancillary Onshore Facilities Where They May Degrade the Scenic Values of the Area

As stated in a previous section, there are a number of proposed tracts located near shore. Platforms in these tracts will be visible from shore on clear days in areas where subsea completion requirements do not prevail.

Ancillary onshore facilities may be constructed where the pipelines come ashore. These facilities would require additional acreage for construction, operation and storage.

h. Impacts of Subsea Production Systems for Use on Deepwater Tracts

Subsea completion and production systems will generate seafloor obstructions which could pose hazards to trawling gear. However, only a small portion of the trawling activities takes place at depths where subsea systems will be used. The possibility that a trawl should snag a subsea completion and cause an uncontrolled flow of oil is extremely remote because of the strength and durability of the materials used in their construction. More likely the fishing equipment would be damaged.

In the case of the Southern California OCS, installation of subsea systems would reduce the numbers of traditional production platforms and could alleviate some potential hazards to navigation; however, some surface structures will be necessary for control, energy input and perhaps storage for many years to come. Limited habitat for deepwater benthic organisms would be altered by placement of submerged production systems. The capability of a subsea production system to withstand an earthquake, slumping, sliding, or other potential geologic hazards is not known at this time. However, they could be directly affected by earthquake shaking, fault rupture of the ground surface, landslides and erosion which could cause rupture of the casing. Surveys of faults and slide areas on the ocean floor would be accomplished and considered prior to site approval. If the above activities occurred, and oil were released into the environment, then the effects would be adverse. For the specific potential impacts for oil spills on biological communities, see Section III.

During adverse weather and sea conditions, maintenance performed from a surface vessel would be hindered. Difficult accessibility could complicate maintenance and inspection of subsea production systems and create problems in controlling a blowout situation should one occur.

The Environmental Protection Agency (EPA) has expressed concern over the potential environmental damage that could result from subsea completions in the event of an uncontrolled discharge of hydrocarbons. In response to the Geological Survey's request for comments on the status of deepwater technology, Federal Register, January 27, 1975, the EPA stated the following:

> "To our knowledge, the only means of reestablishing well control is by drilling a relief well. The time and difficulty in obtaining a suitable drilling rig under emergency conditions are critical and could have a devastating impact upon the environment, since it would be impossible to burn the escaping oil. Until this problem is resolved, EPA continues to express reservations about this portion of subsea production systems. This is especially so in the case of deepwater tracts where the increased use of subsea completions is predicted and where more sophisticated drilling equipment would be required if it became necessary to drill a relief well."

An advantage of subsea completion systems in the case of this proposed sale would be in the opportunity to reduce potential interference with surface navigation and attendant hazards, particularly in established fairways.

The ultimate advantage of subsea systems is the deep water application, which will provide production facilities in water depths where fixed platforms are likely to be unfeasible. Subsea systems can provide a means of initiating early economic returns from the fields where there are delays in the installation of permanent production facilities. Economically, the best advantage is that drilling of development wells can commence immediately after a field discovery, rather than after a wait of about two years while a platform is constructed.

A requirement to utilize subsea systems would reduce potential OCS development because higher costs would require greater potential production before a field could be considered commercial. Additionally, once a field is being produced, higher operating costs could result in loss of reserves due to earlier abandonment of wells. Finally, Federal income could be reduced by smaller bonus bids and lower royalties due to lower production.

2. Impacts Resulting from Accidents

In constructing this section which analyzes past and expected performance in conjunction with OCS hydrocarbon production activities, we have reviewed numerous articles, previous OCS EIS's and several governmental agency spill and accident reports. In the process we have developed an awareness that no simplistic approach or procedure exists which can adequately predict oil spill frequencies or quantities. It is evident, however, that a discussion of sources, causal mechanisms and orders of magnitude is possible and beneficial.

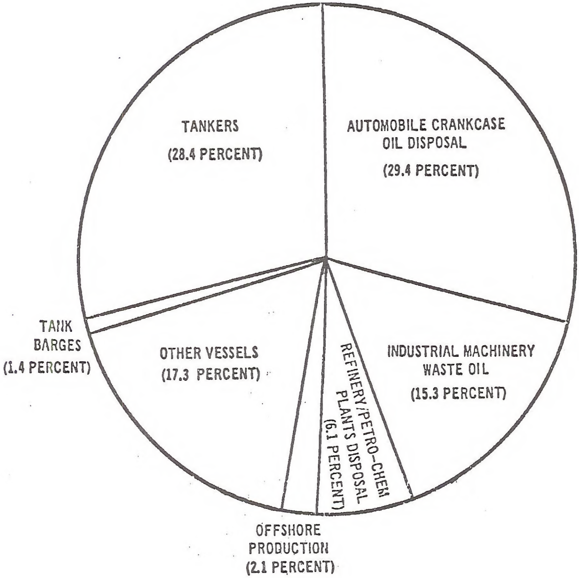
All OCS petroleum hydrocarbon (PHC) production is essentially similar insofar as basic activities and equipment are concerned. Transportation modes, similarly, are consistent, therefore data from a worldwide base are meaningful to the local situation. Differences do exist and complicate analytical attempts. At this point, recoverable resource estimates vary by an order of magnitude, ranging from the U. S. Geological Survey's (USGS) estimate of 1.586 to 2.696 billion barrels, to the Western Oil and Gas Association's (WOGA) figure of 14 billion barrels. The variability in oil spills is vast, ranging over 8 orders of magnitude. The greatest number of spills are small but the majority of oil spilled is occasioned by a few large events. Development of the proposed leases will proceed at a rate determined by variables such as resource promise and availability of capital and equipment. This will result in low production initially, rising to at least one (or perhaps several) production peaks during the lifetime of the proposal. Variable risks of accident therefore will prevail at different periods throughout the proposed development. Past accidents and increasing environmental concern has resulted in technologic advances over the past decade and particularly during its latter half. Similar advances should continue into the future, however, their contribution to spill and accident prevention is not now reliably quantifiable. Analyses based upon implementation of new technology must of necessity rely upon shortened data bases or hypothetical performances, thus lessening the reliability of predictions made thereon. Suggestions have been made that only West Coast spill data be used in spill analysis for this proposal. We feel that this is inappropriate for several reasons. The West Coast data base is short both in time and production and dominated by the Santa Barbara spill of 1969 thus making it subject to the shortcoming of high variance discussed above. Additionally, most of the production has been from State lands which are operated under differing regulations than Federal leases. Oceanographic conditions vary between the Gulf of Mexico and the Southern California Bight, complicating application of Gulf data to this area. Tectonic forces are far more active in Southern California than they are or have been in the Gulf resulting in greater seismic activity for this region. This has produced submarine terrain with a great deal of relief. Many of the tracts proposed for sale are in water much deeper than has been developed for PHC production heretofore, thus presenting challenges for untried technology.

OCS accident frequency generally correlated with increasing activity until the accident frequency peaked in 1968 and commenced a decline continuing through the present. From 1956 through the end of 1974, there were 57 major accidents on the U. S. OCS (USGS, 1975).[1] The diminishing number of drilling accidents since 1968 reflects improvements in both technology and practice. The frequency of production accidents has not decreased so markedly, perhaps because old offshore production facilities and pipelines do not, in all instances, meet the specifications now called for in new facilities and pipelines (CEQ, 1974).

In any complex industrial operation involving heavy equipment, flammable materials, work at sea, large numbers of employees, and a large-scale reliance on complex technology, it is inevitable that accidents will occur. Thus, although theoretically avoidable, impacts resulting from accidents can be viewed as unavoidable in a statistical sense. It has been possible to gather data and derive statistical frequencies for some of these events, and present them below. Offshore production produces only a small portion of total PHC input to the oceans as shown in Figure III-1.

1/ Major accident is defined by the USGS as spillage in excess of 238 bbl (10,000 gals.) and includes blowouts, explosions and fires creating major structural damage or blowouts, explosions and fires resulting in loss of life.

Figure III-1 Sources of Oil Pollution to the Oceans from Porricelli and Keith, in press



"Accidents during offshore operations account for only a small portion of total oil spillage, but locally they can be very significant. Their frequency and magnitudes and the fate and effects of the oil are important factors in OCS development decisions. The Council on Environmental Quality contracted ECO, Inc. and with the Massachusetts Institute of Technology to analyze the probability of offshore oil spills. Sources of data used in their study were:

- o Coast Guard Pollution Incident Reporting System
- o ECO, Inc., data base on tanker casualties (1968-1972)
- o Petroleum Systems Reliability Analysis data base generated by Computer Sciences Corporation for the Environmental Protection Agency
- o M.I.T. data base on large spills
- o A sample of 300 spills at single point moorings worldwide; principally from testimony at hearings before the House of Lords on a proposed Anglesey, England, terminal.

"The most important general features of oil spill statistics are the following:

- o The size range of individual spills is extremely large, from a fraction of a barrel to over 150,000 barrels.
- o Most spills are at the low end of this range; in 1972, 96 percent were less than 24 barrels (1,000 gallons) and 85 percent were less than 2.4 barrels (100 gallons).
- o A few very large spills account for most of the oil spilled (the TORREY CANYON accident of 1967 spilled twice as much oil as was reported spilled in the United States in 1970). In 1970 and 1972, three spills each year accounted for two-thirds of all oil spilled in the United States in those years.

"These facts are highlighted in order to point out the meaninglessness of estimating "average" amounts of oil that might be spilled at particular steps in the development process. Amounts spilled can vary by a factor of 1 million, and single spills like the TORREY CANYON distort the statistical distribution of spill magnitudes. Further, as shown in Table III-6, annual fluctuations are quite large (CEQ, 1974)."

Table III-6
Oil Spill Statistics
(Barrels)

Type of Spill	1971	1972
Petroleum industry-related Spills		
Terminal		
Number	1,475	1,632
Volume	125,800	54,700
Ships (offshore)		
Number	22	32
Volume	400	51,600
Offshore production facilities		
Number	2,452	2,252
Volume	15,600	5,700
Onshore pipeline		
Number	74	162
Volume	8,700	29,300
Total		
Number	4,023	4,078
Volume	150,500	141,300
All spills		
Number	7,461	8,287
Volume	205,000	518,000

Source: The Massachusetts Institute of Technology Department of Ocean Engineering, 1974, "Analysis of Oil Spill Statistics," prepared for the Council on Environmental Quality using U.S. Coast Guard data. (OCS Oil & Gas - An Environmental Assessment, Report to the President, CEQ, 1974).

The CEQ (1974) report continues: "Detectable patterns emerge from statistical analysis of oil spills. For the four major sources of offshore oil pollution shown in Table III-7, there is a remarkable similarity in the number of oil spills in each volume category for 1971 and 1972. The data suggests that the same processes, equipment inadequacies, and operator errors are causing the spills. Computer Sciences Corporation (1973) under contract to EPA, recently analyzed the failures and errors that have

Table III-7

Petroleum Industry-Related Oil Spill Volumes
(Gallons)[1]

	Gallons							
Facility	0-1	1-10	10-100	100 1,00	1,000 10,000	10,000 100,000	100,000 1,000,000	1,000,000 10,000,000
Terminal								
1971	384	247	458	282	77	19	7	1
1972	351	347	544	298	71	16	5	0
Ship (offshore)								
1971	4	6	8	0	4	0	0	0
1972	15	2	10	3	0	0	1	1
Pipeline								
1971	222	403	496	257	41	13	2	0
1972	15	24	61	61	32	7	3	0
Platform								
1971	227	304	395	146	13	2	0	0
1972	431	784	728	244	20	4	0	0
Total								
1971	837	960	1,357	685	135	34	9	1
1972	812	1,157	1,343	606	123	27	9	1

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[1] Forty-two gallons equals 1 barrel. Gallons, rather than barrels, are used to illustrate the fact that most spills involve a small volume of oil.

Source: The Massachusetts Institute of Technology Department of Ocean Engineering, 1974, "Analysis of Oil Spill Statistics," prepared for the Council on Environmental Quality, using U.S. Coast Guard data. OCS Oil & Gas - An Environmental Assessment, Report to the President, CEQ, 1974.

caused these spills. Although restricted by the limited data base, the study suggests that remedy of certain technological and operational inadequacies could significantly reduce the number and size of oil spills. Similarly, USGS has analyzed its oil spill data and is incorporating the results into the Federal inspection and enforcement program."

The following sections discuss the historic record of accidents by source and develop rates and probabilities where possible. We concur with M. I. T.'s feeling that average spillage figures are of limited value (Devanney and Stewart, 1974), however, the amount spilled over the proposal's life and the sources are of more than academic interest, therefore rates and mass emissions are computed.

a. Production Spills

Natural Gas Leaks Associated with Blowouts

Geological Survey reports (USGS, 1975) for the 1956-1974 period note 41 gas leaks associated with well blowouts during OCS PHC operations in the Gulf of Mexico. PHC operations in the Pacific OCS resulted in one gas leak associated with a blowout. Twelve of these incidents involved fire and/or explosion, all in the Gulf of Mexico, and nine involved oil or condensate spills, one of which occurred in the Pacific OCS. Blowouts remained uncontrolled for periods ranging from 2 hours to over 7 months. Four incidents resulted in a total of 27 fatalities and 30 injuries. Property damage ranging from total losses of platforms or work vessels, to minor impairment, resulted from 32 incidents. No estimate of lost gas quantities was made. The lone event occurring on the Pacific OCS was the Santa Barbara spill of 1969.

b. Oil Spills Greater than 50 bbl in Size

Many size-breaks have been made by various authors and governmental agencies. USGS categorizes spills as; minor - less than 238 bbl, medium - 238 - 2381 bbl, major - more than 2381 bbl, and records all spills of 50 bbl or more (USGS, 1975). M. I. T. uses a breakpoint of 1000 bbl, characterizing them as "large" or "small" on either side of that (Devanney and Stewart, 1974) (CEQ, 1974). The National Academy of Sciences (NAS, 1975) refers to "major spills of more than 50 barrels". Coast Guard Pollution Incident Reporting Systems (PIRS) reports record all spills observed by C. G. personnel or reported by others, which reach U. S. navigable waters and which cause a visible sheen on the water's surface. For purposes of our analysis, we consider any spill of 50 bbl (2100 gal.) or more as sufficiently significant to warrant individual attention.

Geological Survey records (USGS, 1975) report a total of 53 oil spill incidents involving 50 bbl or more of oil and condensate for the 1964-1974 period. Two of these occurred in the California OCS, the remainder, in the Gulf of Mexico. The estimated total volume spilled from these incidents is 350,000 bbl. This figure is considered conservative as at least two of the spill volumes are listed as being minimums and other GS estimates tended to be low when compared to the estimates of other investigators. For example GS estimates of the Santa Barbara blowout identified ranges from 300 - 500 bpd [1/] (McCulloh, 1969) to 1000 bpd (USGS, 1975). McCulloh's own "independent guess" ranges from 500 - 5000 bpd, while De Noyer (written commun., Sept. 4, 1969) in McCulloh (1969) estimates 500 - 1250 bpd, relating the lower

[1/] p. 44, p. 77.

figure to Union Oil Co. estimates and the upper one to his reduction of Allen's (1969) estimate by a factor of four. De Noyer seems to accept 1000 bpd for the "most severe periods of the spill". Allen's (1969) "conservative" estimate of the first 10½ days spillage was 5000 bpd. Total outflows during the first one hundred days of the spill were estimated by Allen (1969) to be in excess of 77,000 bbl and by Foster et al. (1971) to range from 78,000 bbl upwards to 780,000 bbl. The President's Panel on Oil Spills, considering several studies, chose a figure of one to three million gallons (24,000 bbl to 71,000 bbl) (Mead and Sorensen, 1970). Geological Survey records (USGS, 1975) indicate initial spillage and subsequent seepage totalling 20,325 bbl to the end of 1972. Kash et al. (1973) compare the Shell blowout in the Gulf of Mexico (1970) spillage estimates, noting the GS figure as 53,000 bbl and EPA as 130,000 bbl as the upper limit.

A distribution of the 53 OCS incidents as to type and amount spilled are presented in Fig. III-2. The Santa Barbara spill is discussed below.

In the following discussion of oil spills by type, several predictions will be made by comparing the volumes of these spills and the total production of crude. Total production during the same period was 3,363,570,010 bbl.

For purposes of analyzing spill quantities and recurrences, the following estimates of recoverable reserves by tract block groupings are used. The low ranges correspond to USGS estimates (Memo. Aug. 14, 1974 and confirming Memo. June 2, 1975) with the lower GS figure used as a minimum; the upper limit is chosen from WOGA's estimate of 14 billion barrels recoverable from a range of 6 to 19 billion barrels

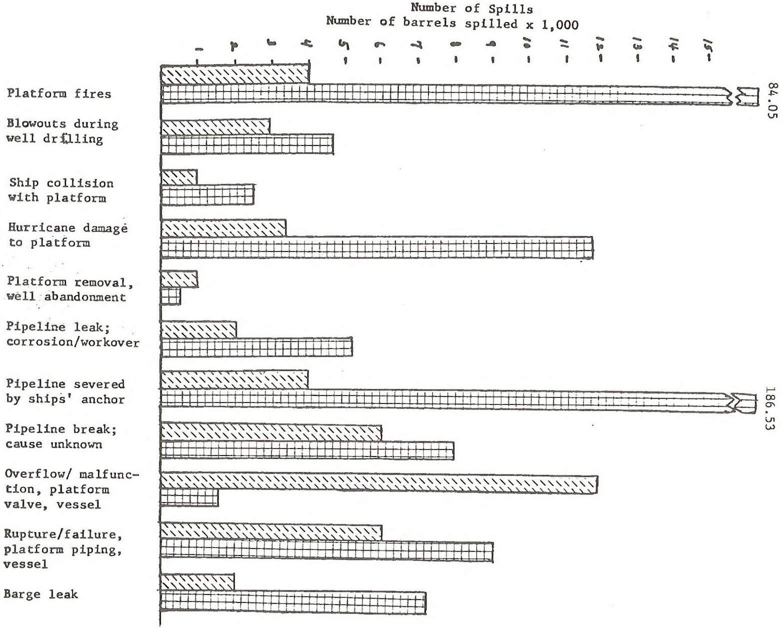


Figure III-2 Oil Spills ≥ 50 bbl. Number and Amount (Data from Geological Survey.)

for the California OCS (WOGA, 1974). WOGA did not give a tract block breakdown of estimated recoverable reserves, however, they did indicate recovery figures in developing "base cases" for subareas which very roughly correspond to our tract block groupings. These allocations are used to apportion the high case production by area.

Estimated Recoverable Reserves by Area

Area	Million Barrels Oil Low	Mean	High	Peak Production Reached
San Pedro Bay	709	1630	2550	CA 1985 - 1990
Santa Monica Bay	329	1380	2430	" " - "
Santa Rosa - Cortes North	242	1961	3680	" 1990 - 2000
Santa Rosa - Cortes South	239	2624	5010 1/	" 2000 - 2010
Santa Barbara - Catalina	67	-	- 2/	" 1990 - 1995
	1586	7595	13670	" 1990 - 2005

i. Pipeline Accidents

Spillage quantities have been estimated for this sale based on data taken from the Gulf since implementation of more stringent construction regulations and monitoring techniques. The matter is complicated by the injection of such difficulties as more tortuous bottom terrain in this area as compared to the Gulf of Mexico and the effect of this topography combined with greater average wave and tidal amplitudes within the Southern California Bight than in the Gulf which could affect the intensity of bottom currents.

1/ Two separate areas combined which correspond to SR-CS.

2/ No separate figure given. Estimate is included in adjacent Santa Monica Bay and Santa Rosa - Cortes North areas.

During OCS operations, more oil has been spilled from pipeline accidents than from all other sources combined. In October 1967, a vessel underway during a storm and with its anchor inadvertently left out, snagged and severed a pipeline about 20 miles west of the mouth of Southwest Pass, Mississippi River delta, Louisiana. The resulting spill went undetected for nearly two weeks, releasing over 160,000 bbl. of oil into the sea. In March of 1968, another anchor/pipeline accident resulted in a 6,000 bbl. spill. In February of 1969, a pipeline leak released over 7,500 bbl. into the sea; the cause was never determined.

Beginning in 1969, several actions were undertaken to decrease this inordinately high volume of spillage per accident and to keep the frequency of recurrence low. Since 1969, the Bureau of Land Management, through administrative procedures, has required the burial of all new common carrier pipelines with a minimum of three feet of cover out to a water depth of 200 feet. Where the pipelines cross shipping fairways and anchorage areas, they must be buried at least 10 feet deep. In water depths of less than 200 feet, only the lines in the gathering system between adjacent platforms of a particular oil or gas field may remain unburied. Permits to construct such lines are granted by the Geological Survey and the decision to bury is made on a case-by-case basis. The water depth requirement for pipeline burial may be increased to 250 ft. for this sale.

In connection with regulations formulated by the Office of Pipelines Safety (OPS), the Department of Transportation (49 CFR Parts 192 and 195) offshore pipelines were required to be coated with tightly bonded, moisture impervious materials followed in many cases by a layer of dense concrete for mechanical and corrosion protection. In addition to coatings, impressed currents or sacrificial anodes were required to protect against electrolytic corrosion. The OPS regulations also require continuous line pressure monitoring with some type of communication system (a built-in-alarm or automatic shut-down system is normally used), and regular inspection of the pipeline route for leaks and other irregularities.

Other features used by industry also serve to mitigate against accidents: continuous metering systems, automatic high pressure shut-downs, and remotely controlled mainline block valves that can isolate sections of a line.

Caution should be inserted at this point. In established oil and gas fields where older lines are present, corrosion will be in a more advanced state, the line may be poorly buried if at all, and all of the above-mentioned requirements for safety and control features may not apply. In fact, industry spokesmen have estimated that 48% of all pipeline leaks occur in lines that have been in use for 15 years or more.

The latest pipe-laying and monitoring techniques, combined with modern materials and equipment, could partially insure that the pipeline required for this potential sale will function in an adequate manner and still offer a high degree of reliance.

Prior to the new regulations concerning pipelines, the spillage rate from 1967 to 1970 was 0.023% of the total production. From 1970 through 1974 with the regulations in effect, the spillage rate is .0015%, about an order of magnitude less. Pipeline transport is technically and operationally feasible presently from most San Pedro and Santa Monica Bay and some Santa Rosa - Cortes Remove tract blocks and will probably be the transportation mode chosen. Estimated recoverable reserves pipelined from these tract blocks range from GS's 1,267 million barrels to a WOGA estimate of 8,232 million barrels. If the above spillage rate remains valid throughout the life of the proposal, the following quantities of oil will be spilled over its life.

Area	Production Estimate Million Barrels Oil*		Total Spillage - BBL
San Pedro Bay	Low	709	10,635
	Mean	1630	24,450
	High	2550	38,250
Santa Monica Bay			
	Low	288	4,320
	Mean	1207**	18,105
	High	2126**	31,890
Santa Rosa-Cortes North			
	Low	237	3,555
	Mean	1896 **	28,440
	High	3556 **	53,340
Santa Rosa-Cortes South			
	Low	33	495
	Mean	367	5,505
	High	701	10,515
TOTALS			
	Low	1267	19,005
	Mean	5100	76,500
	High	8933	133,995

* To be pipelined

** Contains portion of reserve estimates for Santa Barbara - Catalina Tracts

Although the total amount spilled throughout the proposal's lifetime is important, recurrence and quantities are more important both biologically and for planning of containment activity. Devanney and Stewart (1974) developed such information for hypothetical hydrocarbon finds on the Atlantic and Gulf of Alaska OCS. Their analysis was based on volume landed as the exposure variable and did not evaluate such other variables as number of producing wells, number of platforms, or number of pipeline miles. Exposure for the analyses was based on a large field consisting of 2.044 billion barrels recoverable, a medium field of 0.567 billion barrels recoverable and a small field of 0.122 billion barrels recoverable. WOGA (1974) estimates, based on worldwide statistical data, that the call for nominations area would provide recoverable reserves distributed by field size as follows:

4 fields of 1 billion barrels or more
8 fields of 0.5 billion barrels to 1 billion barrels
14 fields of 0.1 billion barrels to 0.5 billion barrels

Devanney and Stewart (1974) note that it is not possible to differentiate from the data, between leaks emanating from gathering lines and those from transmission lines. This makes it difficult to evaluate the relative efficacy of tanker versus pipeline transport since the gathering net is common in both systems. Further study is necessary to resolve the problem of transportation mode. A second problem they noted was that all but three of the large (71,000 bbl) pipeline spills they identified were in shallow coastal channels in the Gulf of Mexico where causes such as damage by a tug's propellor were extant. Adequate burial should preclude that type of accident. For this reason, they developed bar diagrams showing incidence densities based both on all known U. S. offshore pipeline spills, and all large non-coastal U. S. pipeline spills for the 1967-72 period. These are reproduced as Figure III-3 and each one of the sizes falls within the respective size range for fields estimated by WOGA to potentially be present. Spill probabilities for portions of and the total area of the proposed sale are discussed in a subsequent section.

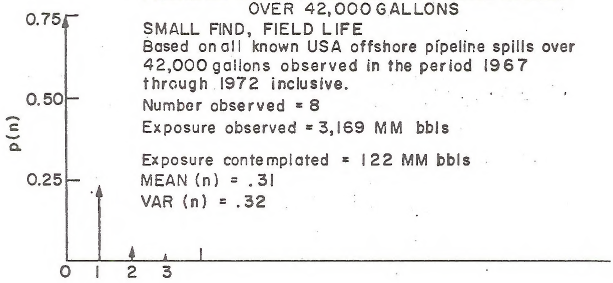
Although the new regulations have brought the spillage rate down, the problem of pipeline leaks from anchor dragging has not been completely resolved. As a part of our pipeline management program, we will continue to investigate the economics and the burial system of pipelines.

Strictly on a judgment basis and with no reference to existing statistics, it is estimated that pipeline breaks may range from zero in the early years to several incidents per year after approximately 20 years.

ii. Oil and/or Gas Well Blowouts

The control of imminent blowouts by increasing mud weight and activation of blowout preventers is discussed elsewhere. In the event the control systems fail, however, the well will blow out of control, and if it is an oil well, it will release large quantities of oil into the environment. If a gas well blows out, the escaping gas either burns or is dispersed in the atmosphere.

FIGURE III-3a DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS


SMALL FIND, FIELD LIFE

Based on all known USA offshore pipeline spills over 42,000 gallons observed in the period 1967 through 1972 inclusive.

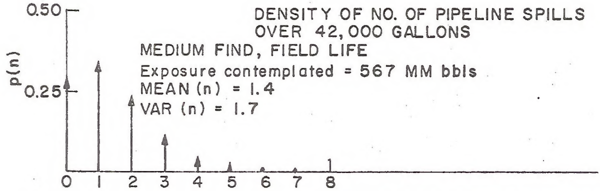
Number observed = 8

Exposure observed = 3,169 MM bbls

Exposure contemplated = 122 MM bbls

MEAN (n) = .31

VAR (n) = .32

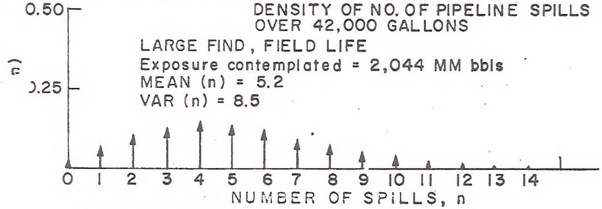

DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

MEDIUM FIND, FIELD LIFE

Exposure contemplated = 567 MM bbls

MEAN (n) = 1.4

VAR (n) = 1.7


DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

LARGE FIND, FIELD LIFE

Exposure contemplated = 2,044 MM bbls

MEAN (n) = 5.2

VAR (n) = 8.5

(Devanney & Stewart, 1974.)

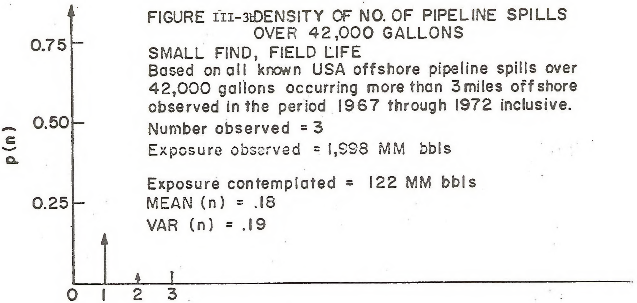


FIGURE III-3b DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

SMALL FIND, FIELD LIFE

Based on all known USA offshore pipeline spills over 42,000 gallons occurring more than 3 miles offshore observed in the period 1967 through 1972 inclusive.

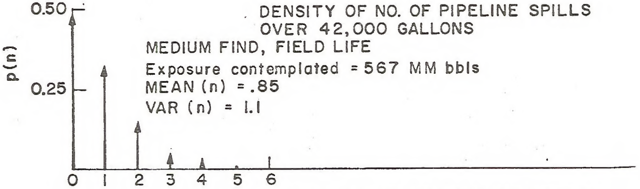
Number observed = 3

Exposure observed = 1,998 MM bbls

Exposure contemplated = 122 MM bbls

MEAN (n) = .18

VAR (n) = .19



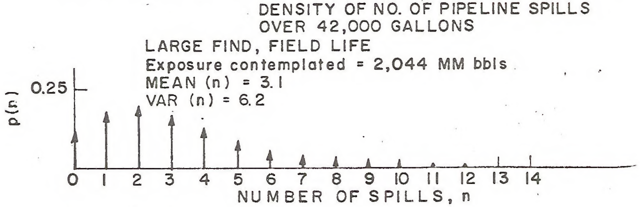
DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

MEDIUM FIND, FIELD LIFE

Exposure contemplated = 567 MM bbls

MEAN (n) = .85

VAR (n) = 1.1



DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

LARGE FIND, FIELD LIFE

Exposure contemplated = 2,044 MM bbls

MEAN (n) = 3.1

VAR (n) = 6.2

One example of a blowout during well drilling is the Santa Barbara incident.

Santa Barbara Spill

Straughan and Kolpack (1971) report that on January 28, 1969, a blowout occurred below Union Oil Company's fixed drilling Platform A in the Santa Barbara Channel, about six miles southeast of Santa Barbara, California. This blowout and spill occurred through an existing fault in the ocean floor adjacent to the well after gas under high pressure from a deep reservoir was accidentally injected into shallow reservoir sands. The resulting build-up of pressure in the shallow reservoir sands soon exceeded the strength of the overlying rock layer and caused a rupture to occur. The rupture formed a fissure zone, thus opening a passageway between the hydrocarbon reservoir and the sea bottom (Reinhart, 1970).

Total initial spillage was estimated by the Geological Survey to be 10,000 barrels, with subsequent leakage amounting to about 8,500 barrels. Other estimates of spillage range from 70,000 to 700,000 barrels (Oppenheimer, 1972). 1/

Excluding hurricane damage, 42 wells of a total of 12,715 drilled, have blown out spilling an average of 1937 bbl per spill. This equals a rate of 0.33%. of wells drilled, blowing out through 1974.

iii. Oil Spills Resulting from Platform Fires

Platform fires can be ignited by a variety of events. Most are undoubtedly caused by combustible hydrocarbon liquids or vapors being brought into contact with arcing electrical devices and

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1/ OCS Public Hearing, August 23, 1973, New Orleans, La.

overheated mechanical devices; more rarely they could be ignited by lightning or static electricity. Work activities such as welding have sometimes been a cause. Sometimes, platform fires first involve the accidental ignition of fuel, solvent, or heat exchanger fluids. If caught soon enough, these small fires are usually controllable, but once a storage tank or well catches on fire, major structural damage occurs and adjacent producing wells on the platform may have their piping severed and also contribute to the fire. It is for this reason that we have chosen to group accidents of admittedly diverse causes under the heading "platform fires". By far, the vast majority of fires are extinguished quickly, before serious damage is done. But once a fire burns out of control, it usually leads to damage of the wellheads and multiple well involvement.

If producing wells are damaged in a way that allows them to flow freely and be ignited, they are usually allowed to burn while operations are underway to control the wild wells from a remote location. In this way, a high percentage of the hydrocarbon liquid expelled by the well is burned. This in turn results in less fire hazard from floating oil near control operations such as relief well drilling and in lower levels of ocean pollution. If a blowing well is releasing mostly or entirely natural gas, the possibility of ocean pollution is minimal. However, the safety of personnel and the security of the platform or drilling structure are imperiled should a fire occur. The decision whether or not to extinguish a gas fire depends on the circumstances of the moment. For example, it might be advisable to allow a gas well fire to burn while remedial action is being prepared if the structure and personnel are not in jeopardy. This would preclude accidental ignition while personnel were in the area of gas accumulation. The overall thrust, however, is to extinguish the fire quickly and bring the well under control. Eight small platform fires have occurred in the California OCS, with no wells being ignited or damaged.

An example of an apparently spontaneous platform fire which resulted in the ignition of several producing wells and extensive damage to the platform is the Chevron Fire of 1970 (U. S. Department of Interior 1970).

From March 10 through March 31, 1970, several methods were successfully used to control six of the seven wild wells on the platform (one well sanded up and plugged itself). These included dynamite, relief well drilling, wellhead repair, weighting and sealing chemicals and activation of downhole safety valves.

USGS (1975) estimated the total volume of oil spilled at about 30,500 barrels. Oil from the spill was a light crude, containing a high proportion of lower boiling constituents and a relatively low concentration (about 10%) of aromatic hydrocarbons. Through a fortunate set of circumstances, the oil was sprayed high into the air under great pressure and frequently into considerable wind, so that far more evaporation took place than usually occurs during a spill. Samples collected 500 feet from the platform and analyzed by Federal Water Quality Administration (FWQA) laboratories showed a loss in volume of

16%, all in the lighter ends. Also, about 5,000 barrels of oil were removed by skimming. Some 1,500 barrels of chemical emulsifier were used during the spill as well.

Accidents caused by human error during routine rework, maintenance and repair have resulted in at least two significant spills of oil in the Gulf area, along with destruction of platforms, the loss of a work vessel and 13 human lives.

During the history of OCS production there have been many fires of varying sizes. Most have been extinguished before serious damage and pollution occurred. Of 140 recorded explosions and fires through 1974, only six have resulted in pollution of the sea by oil. However, the volume spilled, an estimated 87,109 bbl., is significant. Of even greater significance is the unfortunate injury of 143 men and death of an additional 61 (USGS, 1975).

For the purpose of predicting platform fire-related pollution that could result from this proposal, the incompleteness of the existing data on number of producing oil wells and number of platforms requires that we consider instead, the relationship between pollution and total oil production. The following assumption is made:

> Hazards leading to platform fires and technology used to control fires and blowing wells for the present proposal will not be significantly different from those present in operations in the western Gulf of Mexico and Pacific OCS.

It is significant that Gulf of Mexico, OCS Order No. 5, now requires all new OCS completions (with shut-in tubing pressure less than 4,000 psig) to be protected with surface actuated subsurface safety devices, thus eliminating blowout due to faulty and/or sand cut velocity-actuated downhole safety devices. OCS Order No. 5 also requires that with shut-in tubing pressures greater than 4,000 psi shall be protected with a subsurface controlled subsurface safety device. Pacific OCS Order No. 5 requires surface-controlled subsurface safety devices be installed. Well pressures on the Pacific OCS have so-far been much lower than 4,000 psig.

During the years 1964-1974, total oil production from the OCS Gulf of Mexico amounted to about 2.852 billion bbl., and production from the California Federal OCS for the years 1968 through 1974 totaled just over 126 million barrels for a total OCS production of 2.979 billion bbl. During the same period, Geological Survey accident records indicate 6 incidents of platform fire-related pollution resulting in a spillage of 87,109 bbl. Of the six incidents, only two have not had related involvements such as ship collisions or blowouts. To avoid double counting for spill prediction purposes, the two incidences which are not accounted for under other categories are included here. These amount to 30,600 bbl. or a rate of 0.001%. Based on the above assumptions, we can conclude that the maximum size of a single spill in the future most probably would be limited to the volume of flammable material in storage on the platform at the time the fire started.

iv. Pollution Caused by Hurricanes

Whereas damage and subsequent pollution caused by the passing of a hurricane is not an accident in the strictest sense, lack of adequate preparation for the onslaught of a hurricane can be viewed as an avoidable "accident."

Accident records for the Gulf of Mexico OCS indicate that on October 3, 1964, a hurricane passed over the waters off central Louisiana and destroyed four platforms, resulting in the spillage of 10,280 bbl. of oil. Most of the oil was lost from tanks on the platforms used to store produced oil prior to transshipment by barge. Accompanying blowouts spilled up to 5,180 bbl. of that amount. Other hurricanes in 1965 and 1974 caused damages ranging from lost platforms to oil leakage. In 1974, a pipeline break was attributed to a hurricane and resulted in 2,213 bbl. spilled before discovery. Approximately 14,000 bbl. have been spilled where hurricanes were involved.

For the California OCS the only recorded hurricane during the last 50 years occurred on September 24, 1939, prior to the advent of Federal OCS operations. The threat of significant damage and major pollution incidents caused by hurricanes should not be totally discounted, however, even though the risk is much lower than in the Gulf of Mexico.

Based on the total oil produced during the years 1964-1974 (2.979 billion bbl.), we note that 14,000 bbl. represents a spillage rate of 0.00047% due to hurricane damage. With only one incident on record, no generalization will be made concerning spillage during the life of the proposal.

v. Accidental Spills from Overflow, Malfunction, Rupture or Failure of Platform Piping, Valves, or Vessels

This category of spills is essentially an extension of the "minor" spills, i.e., it includes those spills of the same origin as minor spills, but consists of those that involved the loss of 50 bbl. or more before the condition was corrected. Accident records indicate a total of 19 such spills through 1974. One spill involved a tank rupture which spilled 9,935 bbl. Total spillage was 12,218 bbl., or an average of 643 bbl. per spill. Average spill size without the tank incident is 127 bbl.

Assuming conditions leading to such spills will remain the same in the future, the spillage rate of 12,218 bbl. to 2.979 billion bbl. produced is 0.00041%. Applying this to the low, mean and maximum estimates of production for this proposal, the predicted spillage totals for the life of the proposal are:

	Low	Mean	High
Production	1,586 MMbbl	7,595 MMbbl	13,670 MMbbl
Spillage	6,503 bbl	31,140 bbl	56,047 bbl

vi. Accidental Spills Due to Ships Colliding With Platforms

Considered in this section are spills that occur from platforms resulting from a collision by a commercial vessel. Spills of OCS produced oil from tankers and barges is considered in section vii. Consideration of vessel damage, platform damage, loss of life, and economic loss is included in subsections d. and e. of the following section.

In April of 1964, a freighter off central Louisiana struck and damaged a platform, resulting in a fire and the loss of 2,560 bbl. of oil into the sea. Accident records do not indicate a blowing well, therefore, the source of oil was probably a large storage tank, used to accumulate production for barge transshipment.

There are no recorded ship-platform accidents for the California O.C.S. The loss rate is 0.00009% which gives an estimate that 1,367 bbl. to 11,747 bbl. with a mean of 6,527 bbl. could be spilled from accidents of this type over the life of the proposal. The maximum size of a single accident is difficult to predict. A history on one accident is obviously insufficient for generalization.

vii. Tanker and Barge Accidents and Operations

Tankers and barges contribute oil to the marine environment in several ways. Normal operations result in oil losses from bilge pumping, contaminated ballast discharge, dry docking, terminal operations and fallout from exhaust stacks. Accidental losses include cargo release and bunkers (fuel). All vessels contribute PHC through bilges, bunkering and exhaust emission.

Portions of the crude oil production coming from this sale will likely be transported by vessel to shore. Santa Rosa-Cortes south involves tracts separated from land by water depths exceeding 550m (1800') and, in some cases, by over 900m (3000'). These depths are in excess of current pipeline technologic capability and thus indicate a reliance on barging or tankering for at least a portion of this production.

Santa Barbara-Catalina is separated from land by water depths greater than 550m (1800') to the north and greater than 365m (1200') to the south. Pipeline at the lesser depth has been experimentally laid recently in the Strait of Messina. Use of this route would require some arrangement with the Catalina Island Company which has recently granted a 50 year open space easement to Los Angeles County, which precludes any but recreational development on 80% of the island. Very likely, vessel transport will be necessary here also.

As we indicated previously in the pipeline section, the data base as it was presently available to us does not admit to the degree of refinement necessary to determine the relative risk of pipeline versus vessel transportation of crude oil. Since we anticipate the possibility of at least some vessel transportation, we have reviewed the literature to develop figures for losses due to this mode of transportation.

An early paper by Porricelli et al. (1971) analyzed annual oil pollution of the oceans. The following table contains their allocation of various sources to the oceans:

Estimated Annual Oil Pollution of the Oceans *

MARINE OPERATIONS	METRIC TONS	PERCENT
Tankers		
LOT tank cleaning operations	265,000	5.41
Non-LOT tank cleaning operations	702,000	14.34
Discharge due to bilge pumping, leaks and bunkering spills	100,000	2.04
Vessel casualties	250,000	5.11
Terminal operations	70,000	1.42
Tank Barges		
Discharge due to leaks	20,000	0.41
Barge casualties	32,000	0.65
Terminal operations	18,000	0.38
All Other Vessels		
Discharge due to bilge pumping, leaks and bunkering spills	600,000	12.25
Vessel casualties	250,000	5.11
Offshore Operations	100,000	2.04
NONMARINE OPERATIONS		
Refineries and Petrochemical plants	300,000	6.12
Industrial Machinery	750,000	15.31
Highway Motor Vehicles	1,440,000	29.41
TOTAL	4,897,000	100.00

* The final total does not include oil contributed by recreational boats, hydrocarbon fallout and natural seepage.

It can be seen that the total attributable to tanker operations is 1.457 million metric tons per annum (mta) giving a rate of 0.107% with casualties amounting to 0.021%.

This amount from oil transportation represents 29.8% of the total oil influx. Refineries/petrochemical plants contributed 6.12% and offshore operations 2.04%.

The greatest influx of oil comes from tank cleaning operations (967,000 bbl) and it is obvious that the manner in which these washings are handled will have a major bearing on the ultimate quantities of oil released. Older methodology, still in use on some tankers, involved the washing of tanks with sea water, then discharge of the resulting oily water to the sea. Newer systems retain washings on board, allowing separation of the oil and subsequent discharge of water which is relatively less oily to the sea. The next cargo is then pumped in with the remaining oil. This is known as the Load-On-Top (LOT) system. Its use has drastically reduced oil pollution from tank washing. Its effectiveness depends upon length of voyage and sea conditions enroute. Distances within the proposed sale area are insufficient to allow adequate separation. Therefore, LOT will not be of much benefit in this proposal. Segregated ballast designs would obviate the problem. Other solutions may lie in oil/water separators on board, treatment facilities at the destination or even re-injection of ballast water at the production site.

Tank cleaning amounts to 70% of the discharge, while casualties produce 18%, discharges 7% and terminals 5% according to Porricelli et al. (1971).

Discharge at the level indicated by this paper would certainly be intolerable and implementation of some or all of the various control options would surely be accomplished. We are uncertain as to which options would be exercised and the extent of their effectiveness and are therefore not able to reduce this rate.

Casualty analysis of tankers based on 1969 and 1970 data was presented by Porricelli et al. (1971) and considered 1,416 worldwide tanker casualties which resulted in 269 established polluting incidents. The authors considered both of these figures to be lower limits of the actual figures. An average of 250,000 mta were spilled over the two year period. The authors list several reasons why the volume figure is incomplete and is thus "an absolute minimum". Although statistical data could not give the amount of worldwide pollution from tank barge casualties, the authors estimate an additional 32,000 metric tons per year from extrapolation of tanker data. Barges carried 250 mta which indicates a loss rate of 0.0128%. Tanker loss rates due to casualty are 0.0192%. Figure III-4 gives percent by casualty category.

Of tanker casualties, structural failures comprised only four percent of the incidents but contributed 206,278 long tons over the 1969-1970 sample period (Keith and Porricelli, 1973), a total of 48% of the total spillage. Structural failures account for 90% of the

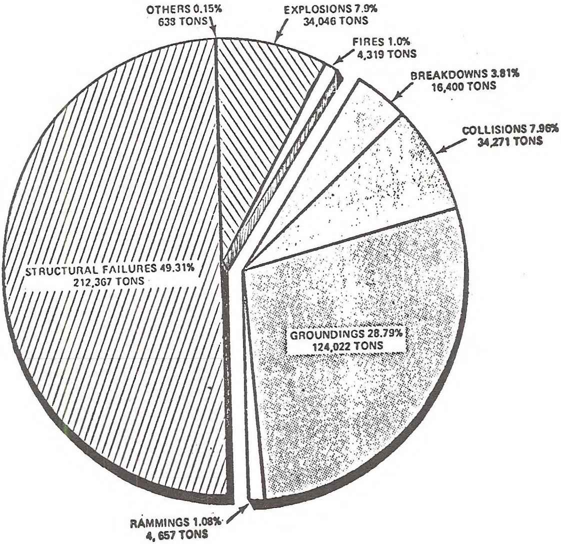


Figure III-4 1969-1970 Tanker Polluting Incidents, Percentage Oil Outflow by Type of Accident from Porricelli and Keith, 1973.

"at sea" (more than 50 miles from shore) pollution, according to Keith and Porricelli, 1973. Since most structural failures are due to weather and sea conditions and old vessels, this portion of tanker spillage is probably not applicable to this proposal since sea and weather conditions here are not comparable to those in many parts of the open ocean and shelter is not far if conditions are threatening. Therefore, dropping that portion of the total spillage attributable to structural futures should give more meaningful rates for this proposal. This gives a casualty rate of 0.0168% for the loss of 218,353 long tons,

As can be seen in the following table from Keith and Porricelli (1973), a large number of incidents and a significant portion of the total outflow occurred within the coastal zone (50 miles or less from shore), and harbors, piers and entrance areas. Since most of the tankers we are concerned with will operate within these areas almost exclusively, the incidence of groundings and collisions will increase over the worldwide data levels. An analysis based on port-calls, if the data is available, would be more useful.

Area Location of the 266 Polluting Incidents
and Outflows During the 1969-1970 Period

Area	Number of Incidents	% of Incidents	Amount of Outflow	Percent of Outflow
Coastal	60	22.6	60,797	14.1
Entrance	59	22.2	83,286	19.3
Harbor	45	16.9	22,651	5.3
Pier	43	16.2	19,159	4.5
Sea	52	19.5	240,003	55.7
Unknown	7	2.6	4,824	1.1
Total	266	100.0	430,720	100.0

Besides normally increasing freighter and passenger traffic levels into local harbors, Alaskan oil tankers will increase traffic levels and spill probabilities. For example, Sohio, with 54% of Prudhoe Bay field reserves, proposes to transport 206,955,000 bbl per year into L. A./Long Beach Harbor to feed a cross-country crude pipeline. This will be accomplished utilizing 10 tankers operating at an average turn-around time of 15 days. 1/ Significant portions of other oil company's Alaskan reserves may also be landed in this area further increasing traffic. Although collision risks will elevate, only eight percent of the total outflow comes from collisions. Groundings are the most significant source of pollution with which we are concerned, accounting for 28 percent of the total and 71 percent of the localized pollution (Keith and Porricelli, 1973). Historical data demonstrates that tanker accidents and polluting incidents are a function of traffic density and water depth, not tanker size (Porricelli and Keith, 1973).

Using this paper's figures of 430,720 tons lost over two years, subtracting "at sea" losses of 240,003 tons and the proportion of "unknown" losses ascribable to "local pollution" of 2,742 tons from this, gives a local loss of 187,975 tons. Considering the carriage of 1,300 million tons per annum, a rate of 0.00723% is obtained.

1/ Standard Oil Company of Ohio: News Release, May 8, 1975

In another paper, review of several previous authors by Charter, Sutherland and Porricelli (1973) found tanker accidents to result in 163,300 tons on the average, with tank barges contributing 31,000 tons. It was not possible to determine from this paper, individual discharge contribution rates, but the total loss rate ascribable to tanker operations was 0.079%. Tanker and tank barge accidents contributed 248,142 tons or a loss rate of 0.0183% (Charter et al., 1973). The total loss rate due to both normal operations losses as well as to casualties is 0.0973%. This rate could rise if tank cleaning and ballast water were disposed of without treatment, or it could drop markedly with effective bilge and ballast treatment. The rate is not representative of what is expectable from this proposal.

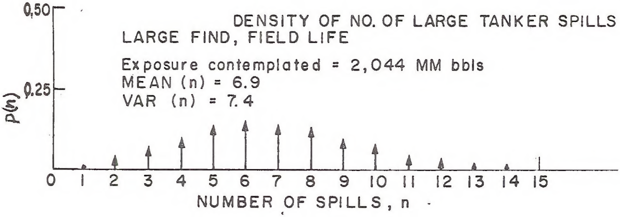
Brummage (NAS, 1975) considers that tankers operating without LOT contribute about 0.35% of their capacity to the ocean. Discharges by tankers purging themselves for dry docking amount to 0.4% of capacity and dry docking averages out to 18 months recurrence interval (NAS, 1975).

Terminal operations varied between Milford Haven's (U.K.) 0.00011% rate of loss for nine years and Portland, Maine's rate of 0.00022% for 1972. The first rate was for large carriers primarily, while the second (U.S.) was for smaller lighters which result in higher losses. The higher rate would seemingly apply in our case, as numerous small vessels will be utilized. Remembering that the oil is handled twice, once for loading and once for unloading, it may be double the Maine rate or 0.00044%.

NAS (1975) notes that bilge and bunkering sources of loss are difficult to support with measured data, but estimate a loss of 10 tons per annum for each ship. For tanker casualties, NAS (1975) adopted Keith and Porricelli's (1973) 0.2 mta (0.0154%) with a range of 0.12 to 0.25 mta.

Devanney and Stewart (1974) in analyzing an extensive data base derived from several different sources, present a rate of 0.016% for tanker casualties. The authors note that non-ECO[1/] data bases are "woefully incomplete". Analyzing tanker spills exceeding 1000 bbl., they found that 83% occurred within 50 miles of land strongly suggesting that spills occurred at either end of the voyage, primarily.

For a small field (122 MM bbl. recoverable) a probability of about 0.30 exists for 1 spill of 1000 bbl. or more and probabilities shift to the right for larger fields as shown below.



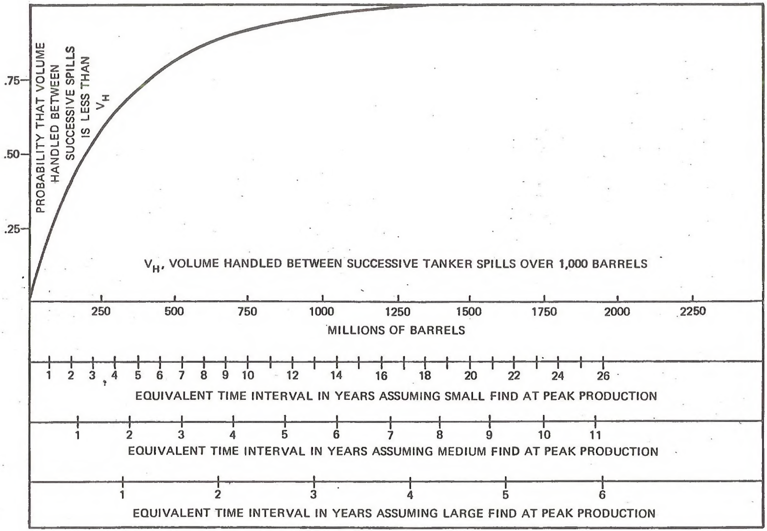
(Devanney & Stewart, 1974)

The probability of no spills over 1,000,000 gallons (23,810 bbl.) is about 0.90 for a small field, 0.55 for a medium field (567 MM bbl. recoverable) and about 0.10 for a large field. The approximate probabilities of one spill over 1 MM gallons for these respective fields are: 0.10, 0.33, and 0.26. if all volume is tankered.

Figure III-5 from Devanney and Stewart gives cumulative amounts of oil handled between tanker spills and indicates equivalent time between spills. By reading up from the lower scales for any given time interval, the probability is found that the time between successive spills will be less than the given interval. The probability for a large spill occurring on a volume-handled basis can be determined similarly. For example, if 20% of this proposal's volume is tankered to shore, then 72 million barrels will be transported annually at high case production and the probability of a large spill occurring in less than one year is determined from the graph and equals about 0.21.

Small spills (less than 1,000 bbl.) were analyzed, based on 1971-1972 Coast Guard data and their cumulative densities of spill numbers are reproduced in Figure III-6,-7, and -8. Cumulative density of small spill size is illustrated in Figure III-9.

In another paper, Card et al. (1975) analyzed tanker casualties for the period 1969-1973, utilizing data from Lloyd's Weekly Casualty



Source: The Massachusetts Institute of Technology Department of Ocean Engineering, 1974, "Analysis of Oil Spills." Prepared for the Council on Environmental Quality. (OCS Oil and Gas - An Environmental Assessment, Report to the President, CEQ, 1974)

Figure III-5 Cumulative Volume of Oil Handled Between Tanker Spills Larger than 1,000 Barrels

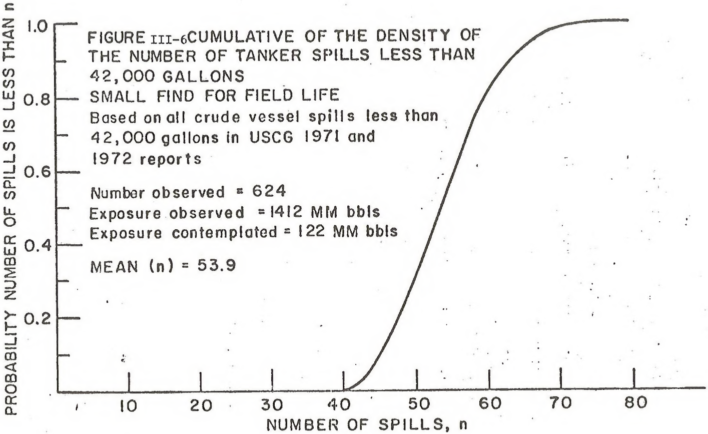


FIGURE III-6 CUMULATIVE OF THE DENSITY OF THE NUMBER OF TANKER SPILLS LESS THAN 42,000 GALLONS

SMALL FIND FOR FIELD LIFE

Based on all crude vessel spills less than 42,000 gallons in USCG 1971 and 1972 reports

Number observed = 624
Exposure observed = 1412 MM bbls
Exposure contemplated = 122 MM bbls

MEAN (n) = 53.9

Devanny & Stewart, 1974.

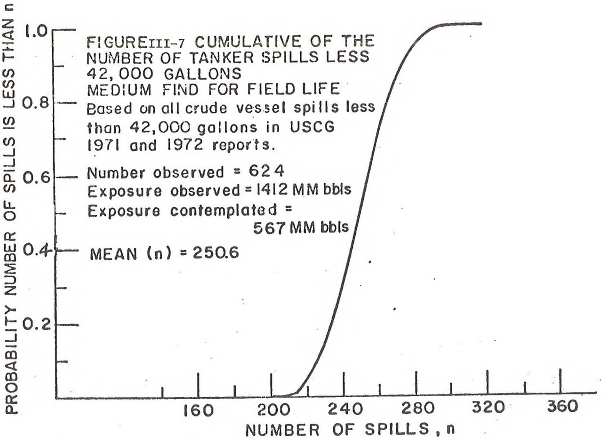


FIGURE III-7 CUMULATIVE OF THE NUMBER OF TANKER SPILLS LESS 42,000 GALLONS
MEDIUM FIND FOR FIELD LIFE

Based on all crude vessel spills less than 42,000 gallons in USCG 1971 and 1972 reports.

Number observed = 624
Exposure observed = 1412 MM bbls
Exposure contemplated = 567 MM bbls

MEAN (n) = 250.6

Deanny & Stewart, 1974.

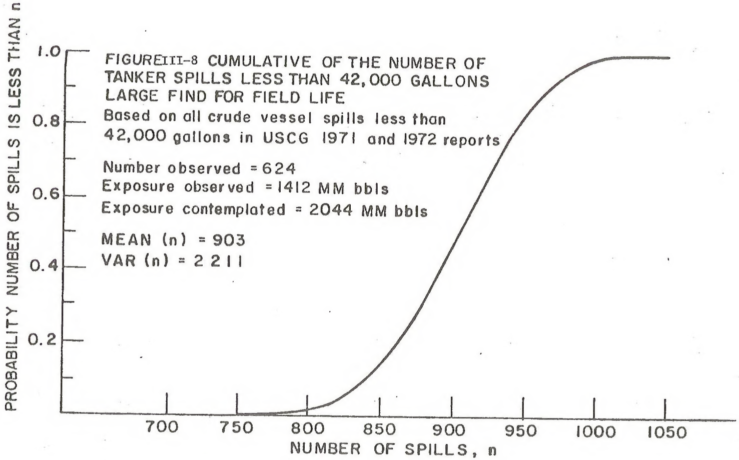


FIGURE III-8 CUMULATIVE OF THE NUMBER OF TANKER SPILLS LESS THAN 42,000 GALLONS LARGE FIND FOR FIELD LIFE

Based on all crude vessel spills less than 42,000 gallons in USCG 1971 and 1972 reports

Number observed = 624
Exposure observed = 1412 MM bbls
Exposure contemplated = 2044 MM bbls

MEAN (n) = 903
VAR (n) = 2211

Devanney & Stewart, 1974.

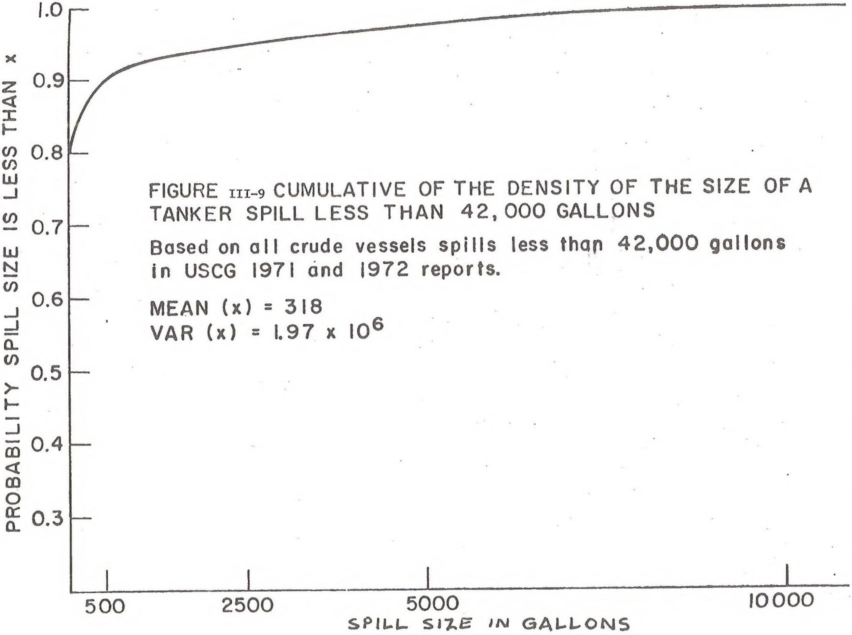


FIGURE III-9 CUMULATIVE OF THE DENSITY OF THE SIZE OF A TANKER SPILL LESS THAN 42,000 GALLONS

Based on all crude vessels spills less than 42,000 gallons in USCG 1971 and 1972 reports.

MEAN (x) = 318
VAR (x) = 1.97×10^6

Reports, supplemented and cross-checked with Coast Guard accident news accounts, Lloyds Register of Shipping Casualty Returns and some oil company information. For the period, ships over 3,000 DWT had 3,183 involvements resulting in 452 oil losses totaling an estimated 950,000 (965,200 metric tons) long tons. At an average annual loss of 190,000 tons (193,040 metric tons) and using the 1971 oil transported figure of 1354.75 million metric tons (NAS, 1975) a rate of 0.00014 (0.014%) is obtained. To make these figures pertinent to this proposal, we have substracted losses due to structural failures which gives a loss rate of 0.009%. This is somewhat lower than other investigator's figures but is possibly due to restricting consideration to ships over 3,000 DWT.

The following table summarizes rates derived from the various papers reviewed by loss category. The last rate in each column is the one which we feel is most appropriate to this proposal and is used to compute expected losses.

SPILLAGE RATE SUMMARY BY LOSS CATEGORY

Rate	Reference	
Bilges, Leaks & Bunkering		
0.000044*	NAS, 1975	
0.000007	Charter et al., 1973	bilges only
0.000077	Porricelli et al., 1971	
0.000050		
Casualties		
0.000148	NAS, 1975 (from Porricelli & Keith, 1973)	
0.000148	Card, 1975	
0.000160	Charter et al., 1973	
0.000166	Keith & Porricelli, 1973	
0.000192	Porricelli, Keith & Storch, 1971	
0.00016	Devanney & Stewart, 1974	
0.000160		
Casualties Less Structural Failures		
0.000096	Card, 1975	
0.000084	Keith & Porricelli, 1973	
0.000090		
Terminal Operations		
0.0000022	NAS, 1975	
0.0000250	Charter et al., 1973	
0.0000540	Porricelli et al., 1971	
0.0000022		
Dry Docking		
0.000369	NAS, 1975	
0.000071	Charter et al., 1973	
0.000369		
Tank Washing		
Without LOT		
0.0035	NAS, 1975	
0.002160	Porricelli et al., 1971	
0.0035		

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*Based upon 10 tons/ship/annum.

Spill Rate Summary (cont)

Tank Washing

With LOT	
0.000352	NAS, 1975
0.000272	Porricelli et al., 1971
0.000352	

Bilges, leaks and bunkering Losses at a rate of 0.00005 due to bilges, leaks and bunkering are computed as follows:

SPILLAGE OVER PROJECT LIFETIME (Million bbl.)

Area	Volume Tankered				
	%	Low	Spillage	High	Spillage
SP	none	-	-	-	-
SM	12.5	41	0.00205	304	0.01520
SR-CN	2	5	0.00025	74	0.00370
SR-CS	86	206	0.01030	4309	0.21545
SB-CAT	100	67	0.00335	-	-
		319	0.01595	4687	0.23435

If all of the production were tankered then the following spillage would be expected:

RESERVE ESTIMATES (MM bbl.)

Low	Spillage	High	Spillage
1586	0.07930	13670	0.68350

In addition to oil tankers, discovery of commercial quantities of natural gas in deep water tracts will require floating gas liquefaction modules, storage and transportation vessels all of which may contribute oil in the amount of 10 tons per ship per annum. Depending upon reserves, we estimate 55 to 600 ship years may be necessary for gas handling and transport, producing a total spillage of from 3,440 bbl. (550 metric tons) to 37,500 bbl. (6,000 metric tons).

Total spillage from this category for gas and oil transport will range from 82,700 to 720,000 bbl. over the life of the proposal if all production is tankered. Our "best estimate" is the range of 19,390 bbl. to 271,850 bbl.

Casualties Losses due to casualties such as collision, ramming, grounding, explosion, fire, and breakdown are computed at a loss rate of 0.000090.

SPILLAGE OVER PROJECT LIFETIME
(Million bbl.)

Area	Low-----Spillage	--------High
SP	---	---
SM	0.00369	0.02736
SR-CN	0.00045	0.00666
SR-CS	0.01854	0.38781
SB-CAT	0.00603	---
	0.02871	0.42183

If all production were tankered then the following spillage would be expected:

(MM bbl.)

Low = 0.14274 High = 1.23030

Terminal Operations Terminal operations will result in a loss rate of 0.0000022 split equally between the loading and unloading end.

SPILLAGE OVER PROJECT LIFETIME
(Million bbl.)

Low	High
0.00070	0.01031

If all production were tankered then the following spillage would be expected:

(Million bbl.)

Low	High
0.00349	0.03007

Dry Docking Dry dock preparatory cleaning will occur approximately every 18 months. If discharge treatment facilities are available, then this source of spillage would be reduced. Based upon no treatment of wash water, the loss rate is 0.000369.

SPILLAGE OVER PROJECT LIFETIME
(Million bbl.)

Low	High
0.11771	1.72950

If all production were tankered then the following spillage would be expected:

(Million bbl.)

Low	High
0.58523	5.04423

Tank Washing This source, like dry dock cleaning, is susceptible to considerable mitigation, given adequate treatment facilities. Whether these facilities are provided or not will greatly affect the quantities of oil released to the marine environment over the lifetime of this proposal, should it be implemented. Other methods such as separate ballast tanks may suffice to mitigate this source. LOT tankering is not workable, because of short trip times, therefore we have computed anticipated spillage based upon the non-LOT loss rate of 0.0035. We have computed alternative rates based on 95% efficiency at treatment facilities for oil removal.

SPILLAGE OVER PROJECT LIFETIME

(Million bbl.)

	Low	High
	1.11650	16.40450
at 95% efficiency	0.05583	0.82023

If all of the production were tankered then the following spillage would be expected:

(Million bbl.)

	Low	High
	5.55100	47.84500
at 95% efficiency	0.27755	2.39225

TANKER SUMMARY - SPILLAGE

(Million barrels)

Category	RESERVE ESTIMATE RANGE Low	High
Bilges, etc.		
Est. To be Tankered	0.01595 (oil)	0.23435
All Tankered	0.07930 (oil)	0.68350
Gas Vessels	0.00344	0.03750
Casualties		
Est. to be Tankered	0.02871	0.42183
All Tankered	0.14274	1.23030
Terminal Operations		
Est. to be Tankered	0.00070	0.01031
All Tankered	0.00349	0.03007
Dry Docking		
Est. to be Tankered	0.11771	1.72950
95% Treatment Efficiency	0.00589	0.08648
All Tankered	0.58523	5.04423
95% Treatment Efficiency	0.02926	0.25221
Tank Washing		
Est. to be Tankered	1.11650	16.40450
95% Treatment Efficiency	0.05583	0.82023
All Tankered	5.55100	47.84500
95% Treatment Efficiency	0.27755	2.39225
TOTALS BY:		
Amount Estimated to be Tankered	0.04880	0.70399
All Production Tankered	0.22897	1.98137

	Low	High
TOTALS BY:		
Wash Water Untreated for:		
Amount Est. to be Tankered	1.23421	18.13400
All Production Tankered	6.13623	52.88923
Treated for:		
Amount Est. to be Tankered	0.06172	0.90671
All Production Tankered	0.30681	2.64446

To use the table to determine an amount spilled over the project's lifetime the following examples are given:

Low case production at our estimated amount of tankering	48,800 bbl.
Wash Water Treated	61,720 bbl.
	110,520 bbl.
High case production at our estimated amount of tankering	703,990 bbl.
Wash Water Untreated	18,134,000 bbl.
	18,837,990 bbl.

viii. Other Spills of 50 Barrels or More

In June 1965, during well abandonment and platform removal, a well break resulted in a spill of 500 bbl. We hesitate to predict that such an accident will happen again. OCS Operating Order No. 3, issued in 1969, requires that a redundant series of bridging devices, weighted muds, and cement plugs be placed in any well or drill hole prior to abandonment. We believe that well or hole abandonment performed in this manner provides an ample margin of protection against any possible communication betweeen subsurface oil bearing formations and the atmosphere.

In two similar incidents, occurring in July 1971, and January 1973, damage to oil storage barges caused spills of 7,100 bbl. of oil into the sea before the cargo could be offloaded onto another barge.

c. Minor Spills

The requirement for reporting minor spills (Table III-8), furnished by the Geological Survey, lists annual totals of minor spills by number, volume, and source, and also lists numbers of slicks sighted.

Table III-8 MINOR OIL SPILLS

Year	Total Number Reported	Source by Number		Total Volume (bbl.)	No. Oil Slicks Sighted, Not Ident. by Source
		Drilling	Prod. & Trans.		
1970	1,200	4	1,196	2,597	745
1971	1,250	13	1,237	2,414	878
1972	1,158	13	1,145	1,812	606
1973	1,392	10	1,382	1,857	958
1974	1,129	--	---	667	-

Oil slicks from unidentified sources are not positively related to offshore drilling, transportation, or production. There is evidence of natural oil seepage in the Southern California Borderland Area, first recorded in the 18th century; long before oil development activities, and seepage still persists in many areas. It is possible that these natural seeps could be the source of some slicks classified as being from an "unidentified source." Other possibilities are ships bilges and tanker cleanings.

We are optimistic about the industry's performance in cleaning up its routine operations and decreasing the amount of chronic spillage. The trend becomes obvious when total minor spills in barrels per month are plotted against time, as has been done in Figure III-10. The smooth curve represents a constant percentage (2.57) decline based on the plotted data. During the period 1970-1973, total oil and condensate production varied by less than 13%, whereas the constant percentage decline curve represents a decrease in minor spill volume of almost 60% over the same period.

If a total of 9,347 bbl. of petroleum liquids were spilled during the period of 1970-1974, and 2.979 billion bbl. were produced during the same period, the spillage rate is 0.0003%. Projecting this rate to the present proposal, where minimum and maximum recovery are estimated, respectively, at 1586 and 13,670 million bbl., the total lifetime spillage would be 0.004758 and 0.041010 million bbl. If the downward trend of minor spill volumes, as shown in Fig. III-10 continues, the figure will be somewhat smaller. By definition, the maximum size of a single minor spill, of course is less than 50 bbl.

d. Collisions Resulting from Conflict Between Ship Navigation and Offshore Structures

During the period July 1, 1962 through June 30, 1971, the Coast Guard recorded 24 incidents of collisions between vessels and fixed platforms. Total damages were estimated to be about $0.4 million to vessels and $3.4 million to structures. Only four injuries and no deaths were reported. Of these, eight accidents involved

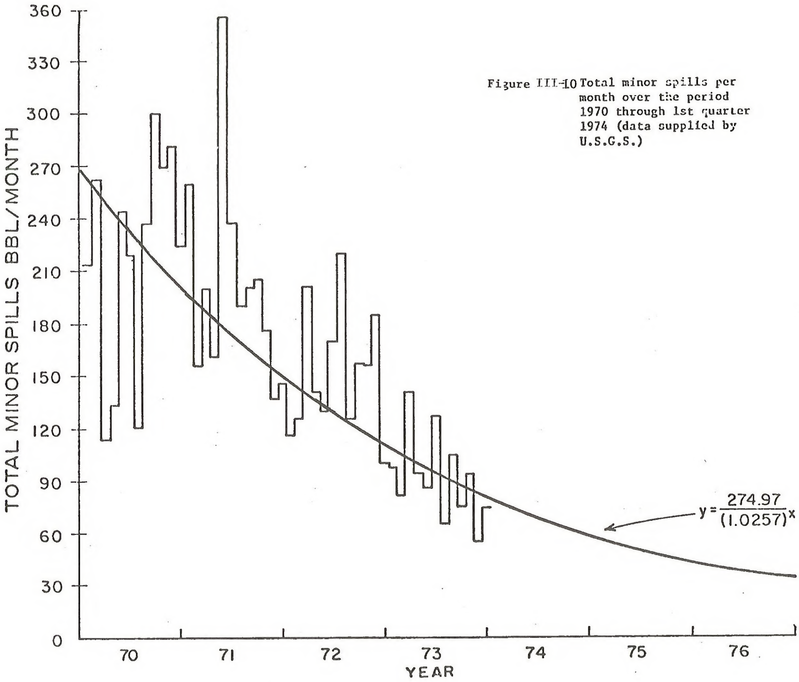

Figure III-10 Total minor spills per month over the period 1970 through 1st quarter 1974 (data supplied by U.S.G.S.)

vessels of over 1,000 gross tons. These eight accidents accounted for $87 thousand of vessel damage (only four vessels reported damage) and over $3.2 million damage to platforms and no injuries or deaths reported. Five of these accidents occurred at night (three within two hours of midnight) and two during daylight. All of the eight major accidents occurred outside established shipping fairways and anchorage areas and only three were less than five miles from these established areas. At least five of the accidents involved foreign flag vessels. The worst of these eight accidents occurred in 1967 when an 11,600 ton foreign flag cargo vessel collided with a platform in Ship Shoal Area Block 214 at 1:30 a.m. during heavy rain, poor visibility, 45 knot winds and 15-20 foot seas. The vessel escaped with damages estimated at $12,000 but damages to the platform were of the order of $1.1 million or 1/3 of the total damages in all eight accidents. Nearly one year following this collision a blowout of gas and condensate occurred on this platform. There was a minimal amount of oil spilled because the well was producing gas.

The remaining 16 incidents of collison between vessels (less than 1,000 gross tons) and platforms caused more damage ($290 thousand) to the vessel than to the platform ($100 thousand). Causes were assigned as 2-weather, 8-vessels and 6-platforms, the platform causes were further defined as 3-equipment failures, 2-insufficient or improper lighting, and 1-improper maintenance. No incidents of ship platform collisons are reported from the Pacific OCS.

e. Accidental Deaths and Injuries on Oil Industry Structures and Vessels

Information supplied by the U.S. Coast Guard reveals that a total of 100 individuals were killed as a result of accidents involving construction, supply, and drilling vessels, workboats, mobile drill rigs, and artificial islands in the Gulf of Mexico and adjacent navigable inland waters during the period 1964-1973. Of these 100 deaths, approximately 66 occurred in water approximately equal to the Federal OCS area. Table III-9 on the following page, provided by the Coast Guard, shows these casualties by source and year. These figures do not include deaths resulting from accidents in which no vessel or rig damage occurred (i.e., persons falling, or knocked overboard, crushed by drilling equipment, etc.). Since complete data is not available for the years 1964-1966, only the data from 1967-73 will be used as a basis for the following predictions.

Deaths due to offshore oil and gas operations involving vessel damage totalled 68 from 1967-73. Of these, 41 took place in international waters and 27 in inland waters. In addition, 35 persons were killed in oil operations in the Gulf of Mexico (both inland and

Table III-9 Total Deaths Reported as Resulting from Vessel Casualty

	Inland Waters Gulf of Mexico										Gulf of Mexico									
											Fiscal Years									
	64	65	66	67	68	69	70	71	72	73	64	65	66	67	68	69	70	71	72	73
Mobile Drill Rigs and Artificial Islands	No info		–	7	–	12	–	–	–	–	No info		–	–	2	1	7	14	6	1
Oil Industry Supply Vessels and Workboats	–	–	–	–	–	–	3	2	–	–	–	–	2	–	–	–	–	4	–	–
Oil Industry Construction And Drilling Vessels	4	1	2	1	–	2	–	–	–	–	22	1	–	1	–	–	2	3	–	–
Sub Total	4	1	2	8	–	14	3	2	0	0	22	1	2	1	2	1	9	21	6	1
Total 100																				

international) with no casualty to the vessel being involved. Using the 41:27 ratio based on deaths involving vessel damage, we estimate that 21 of the 35 deaths not involving vessel damage will occur in international waters. This gives a new total of 62 deaths occurring in international waters from causes related to OCS oil and gas operations. Based on this information, approximately 9 deaths per year may be expected in the Gulf of Mexico as a result of offshore industry activity in OCS waters. With the much smaller size of operations on the Pacific OCS, this number drops to less than one death per year. Below is listed a summary of injuries reported to the Office of Workmen's Compensation Programs under the Outer Continental Shelf Lands Act by district. The years are recorded as Fiscal years.

Table III-10
Total Injuries Reported Under
the OCS Lands Act

ALL DISTRICTS

		Cases Reported	
Fiscal Year	Non-Fatal	Fatal	Total
1968	3,583	28	3,611
1969	3,395	25	3,420
1970	3,261	21	3,282
1971	2,822	32	2,854
1972	1.975	14	1,989
1973	2,307	21	2,328

f. Summary

This section summarizes the predicted quantities of oil spilled as developed in the preceding sections, where such predictions are plausible. In addition, it includes probabilities for various events occurring in conjunction with production and transportation. These probabilities were developed in the CEQ; OCS Oil and Gas - An Environmental Assessment, Report to the President (1974).

This summary assumes transportation of crude by pipeline for all of San Pedro Bay. Some tankering or barging of production from the other areas is expected.

Table III-11 TOTAL OIL SPILLED FOR THE LIFE OF THE PROPOSAL (40-60 years)

		Quantity	
Spills Greater Than 50 bbls.	Rate	Low (bbl)	High (bbl)
- Pipeline Accidents	0.000015	19,005	133,995
- Well Blowouts	0.000027	(42,822)	(369,090)
	0.000045 1/	71,370	615,150
- Spills from Platform Fires	0.000010	15,860	136,700
- Hurricane (no prediction, frequency of occurrence is so low for Southern Calif.	----	---	---
- Overflow, Malfunction or Rupture	0.0000041	6,503	56,047
- Ship Collision	0.0000009	1,367	11,747
- Tanker and/or Barge 2/	0.000346	110,374	1,621,702
Minor Spills	0.000003	4,758	41,010
		229,237	2,616,351

1/ Using 75,000 bbl. spill estimate for Santa Barbara spill instead of USGS estimate of 23,610 (USGS, 1975).

2/ Assumes our estimate of amount to be tankered and treatment of wash water.

Probabilities of Spills from Platforms and Pipelines

For an oil field find of medium size,[1] there is about a 70 percent chance that at least one platform spill over 1,000 barrels will occur during the life of the field. For a small oil field find, there is about a 25 percent chance of one platform spill over 1,000 barrels and for a large oil field find, there is over a 95 percent chance of a platform spill over 1,000 barrels, during the life of the fields. The probability of pipeline spills follows the general pattern exhibited by platform spill statistics. Figure III-11 which shows the volume of oil handled on a platform between successive spills, indicates that there is about a 40 percent chance that 250 million barrels of oil will be handled between large spills. If a large platform spill does occur, there is an 80 percent chance that the volume will exceed 2,380 barrels and a 35 percent chance that it will exceed 23,800 barrels.

Figure III-11 also shows that the probability of successive spills increases rapidly as the size of the find increases. Conversely, this means that large spills will occur more often--for an equal increase in probability of a spill, 4.5 years will elapse in a small find and only 1.0 year elapses in a large find. Biologically, the time between large spills may be at least as important as the number of such spills as the ability of ecosystems to recover between successive oil spills is involved.

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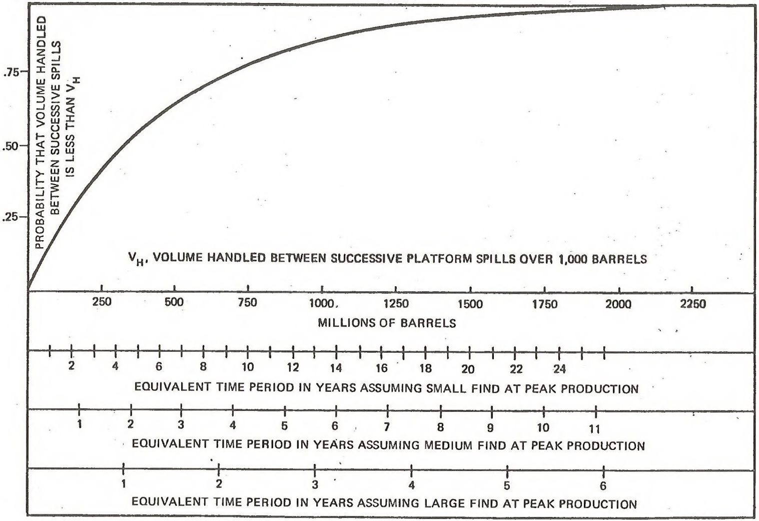
[1] A medium find was defined by M.I.T. as 2 billion barrels of oil in place and a gas/oil ratio of 1,000:1. A small find was defined as 500 million barrels of oil and 500 billion cubic feet of gas and a large find as 10 billion barrels of oil.



Source: The Massachusetts Institute of Technology Department of Ocean Engineering, 1974, "Analysis of Oil Spills." Prepared for the Council on Environmental Quality. (OCS Oil and Gas - An Environmental Assessment, Report to the President, CEQ, 1974)

Figure III- 11Cumulative Volume of Oil Handled Between Platform Spills Larger than 1,000 Barrels

Total Volume of OCS Oil Spills

The total volume spilled over the life of a field, although not as important as the frequency and magnitude of individual spills, is of interest. Table III-12 shows that the number and total volume of spills for platforms, pipelines, and tankers are of the same order of magnitude for a given field size. Platforms have the lowest frequency and volume and tankers the highest.[1]

If the oil from a small field is transported by tanker, the probability that there will be no spill over 1,000 barrels is 52 percent; if oil is transported by pipeline, the probability is 75 percent. There is a higher probability of an extremely large spill from large pipelines than from tankers. Thus, if massive (above 240,000 barrels) spill volumes, which have a low (less than 1 percent) probability of occurring, are the main concern, tankers may be preferred over pipelines.

In interpreting these data, one must keep in mind that they are based on past experience and do not adjust for future improvements or production economics. If low-productivity OCS fields are discovered, replacement of pipelines 15 to 20 years into the field's life may be uneconomical; this could lead to higher incidence of pipeline leaks. Pipeline spill data include three major shallow water spills which may not be relevant to the Atlantic or Gulf of Alaska. The tanker spills include those from ships registered in all nations; however, American ships have a better record than all others. (CEQ, 1974).

Table III-12 Oil Spilled Over the Life of a Field

	Number of spills	Total volume (barrels)
Small Find		
Platform	0.28	7,200
Pipeline	0.31	13,900
Tanker	0.41	19,900
Medium Find		
Platform	1.3	33,300
Pipeline	1.4	62,900
Tanker	1.9	92,400
Large Find		
Platform	4.7	120,500
Pipeline	5.2	233,300
Tanker	6.9	335,700

Source: The Massachusetts Institute of Technology Department of Ocean Engineering, 1974, "Analysis of Oil Spill Statistics," prepared for the Council on Environmental Quality

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[1] Although the M.I.T. approach does not consider average spillage rates valid, mean spill rates were derived at the request of the Council. M.I.T.'s computed ratio of the mean spill rate to the total volume of oil handled for platforms is 0.006 percent, for offshore pipelines is 0.011 percent, and for tankers is 0.016 percent.

Oil Spill Trajectories

Oil slicks residing at the sea's surface will move in response to surface currents and wind. While in transit, oil is altered physically and chemically by emulsification, dissolution, flocculation with suspended sediment, volatilization, and biochemical activity. The time in transit is important as toxicity, adhesive quality and other factors change through time.

Drift bottles indicate the behavior to be expected from oil slicks. Numerous drift bottles have been released along the California and Baja California coast and, according to one study in which 51% of the bottles were released in the Southern California region (Table III-13), 82% of the total number of returns were from releases in the Southern California region and 75% of the returned bottles were released within 25 miles of the coast. Ratio of returns to releases by distance from shore is shown in Table III-14. Two bottles were returned from 160 miles (193 km) out (Schwartzlose, 1963).

Table III-13

Number of Drift Bottles Released by Distance from Shore, 1955-1959

	Miles from shore					
	160	120	80	40	20-0	Total
Southern California						
No. released	1,296	2,606	4,841	3,744	6,922	19,409
No. returned	2	17	181	282	1,305	1,787
Percentage returned	0.2	0.7	3.7	7.5	18.8	9.2

From: Schwartzlose, 1963.

Table III-14.

RATIO OF RETURNS/RELEASES

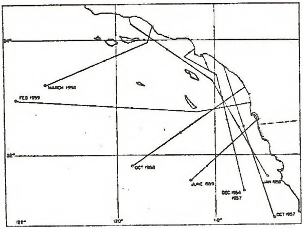
Distance from shore	J	F	M	A	M	J	J	A	S	O	N	D
0-20	14.1	10.8	22.4	26.5	20.4	28.7	25.2	20.0	23.7	15.8	10.3	8.0
20-40	7.7	8.0	6.2	8.0	10.2	11.1	6.7	6.9	11.6	5.3	5.3	4.7
40-80	3.3	2.8	5.2	1.1	3.1	3.9	2.8	5.2	7.9	4.1	2.5	2.9
80-120	0	0.4	1.0	0	1.6	1.2	2.4	0	0	0	0.7	0.4

Schwartzlose, 1963.

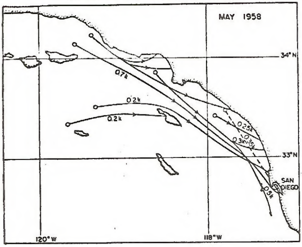
Drift bottles do not give the route but do give the initial and end points. Circulation in the Bight is dominated by the California current to the west and the Southern California countercurrent in the nearshore area. Surface currents are somewhat complicated and involve several large eddies. Drift bottles very rarely pass from the Bight to the north and trajectories are easterly to southeasterly which agrees well with the dominant wind direction which is from the northwest.

Drift bottle returns are shown in Figure III-12 for Southern California. Figure III-13 shows the extreme limits of travel for drift bottles and the potential distances floating materials may be carried.

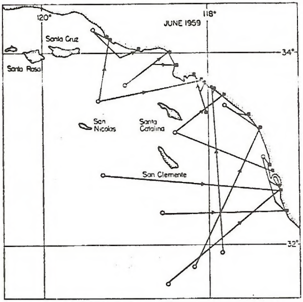
Intersea Research Corp. (1974) computed oil spill trajectories for the Southern California Bight which exhibit southeasterly to easterly vectors, with some sources between Santa Barbara Island and the northern islands exhibiting northeasterly components during portions of the year. This is the prevailing condition during the year except during frontal passages and Santa Ana conditions. Slicks move at velocities ranging from 3.3% to 3.4% (Torrey Canyon) up to 10% to 20% of the surface wind speed (Swift et al., 1970).



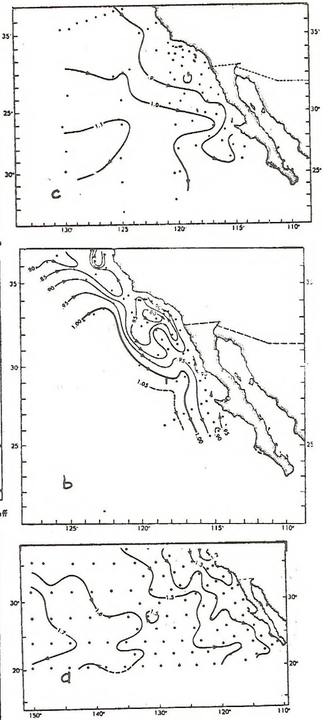
Indications from drift bottles as to how far west and south water enters the southern California eddy.



May, 1958, drift bottle returns indicating no eddies off southern California.

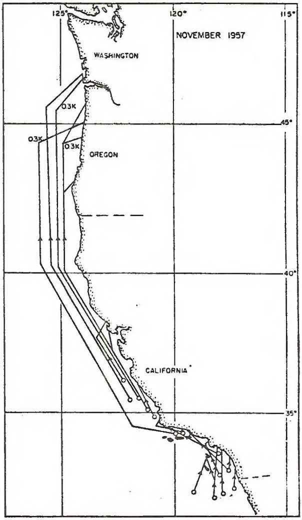


Drift bottle returns in June, 1959, indicating the eddies off southern California.



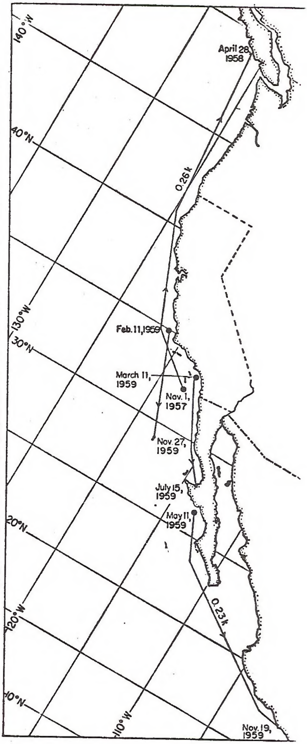
Ocean currents off the western coast of North America. (a) Surface current, August 1955, dynamic height anomalies, 0 over 1000 decibars, contour interval, 0.10 dynamic meters; (b) Surface current, November 1952, dynamic height anomalies, 0 over 500 decibars, contour interval, 0.05 dynamic meters; (c) Surface current, March (composite), dynamic height anomalies, 0 over 500 decibars, contour interval, 0.10 dynamic meters;

Figure III-12. Ocean Currents off Southern California. Drift Bottle figures from Schwartzlose, 1963; currents from Reid, et al., 1958.



The countercurrent during November, 1957.

Figure III-13. Direction and Limits of Surface Transport of Southern California Currents as Indicated by Drift Bottles. (Schwartzlose, 1963)



Extreme north and south movements of drift bottles.

It can be assumed from existing data that oil spilled and not contained and recovered will reach the shore of either an island or the mainland the majority of the time with potentially great rapidity, under conditions of wind and current which are not atypical of the region.

3. Seismic Impacts

The main factors in an earthquake are the magnitude, duration, and the interaction of the soil-structure system. During an earthquake lateral forces (ground motion) are produced, which decrease with distance from the seismic epicenters or fault. Potential hazards offshore differ slightly from those encountered on land. Sea floor sediments usually have a water-saturated unconsolidated surface layer underlain by a more competent denser sedimentary formation.

As indicated in Section II A and Appendix 10 A, Southern California is in an area of high seismic activity; although it has not been the site of a great earthquake (magnitude 8), the magnitudes reach above magnitude 6 both on and offshore.

In these areas where tectonic activity is present, many hundreds of microseisms will occur daily. The magnitude of the microseisms are of such a low order that their occurrence can only be detected by sophisticated equipment.

The distribution and intensities of earthquakes for a forty year period (1932-1972) are seen in Section II.A. in Figures II-5a through 5f, and Figure II-5 shows large events. From the visual aids, it is seen that the number of epicenter locations decreases as distance from shore is increased. The reason for this is not strictly because of decreased seismic activity in the offshore areas, but probably is due to insufficient monitoring. As seen from Figure III-14,

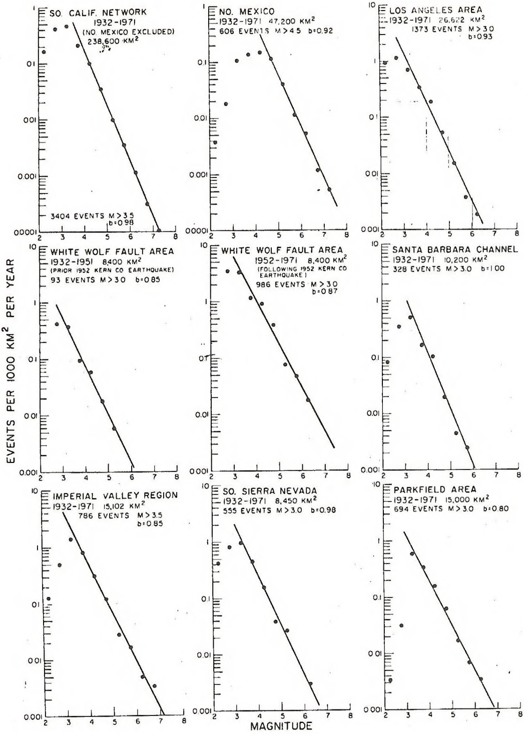


Figure III-14 Interval recurrence curves for each of the areas shown in Figure III-15 Note that the ordinate scales are identical for all curves except for the curves for the southern California network and north Mexico areas (Hileman et. al. 1973)

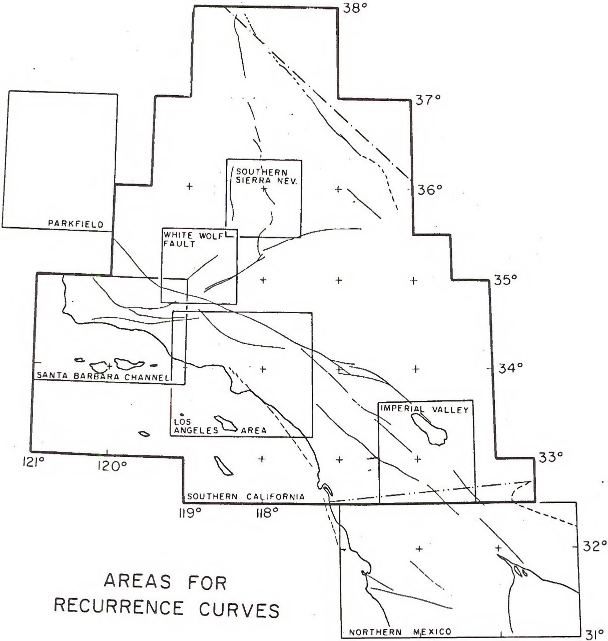


Figure III.-15 Outlines of the various areas for which recurrence curves are presented in Figure III-14 Note the heavy outline for the entire southern California area of coverage, excluding northern Mexico (Hileman et al. 1973).

it is apparent that there are considerably more seismographic stations in the onshore region than in the offshore region. Also, prior to 1970, the only offshore seismographic station was on Santa Catalina Island. With this inadequate distribution of seismograph stations in the offshore region, epicenters can usually only be located within 5-15 km (8-24 miles) and smaller events can go unrecorded. This situation may be corrected by the installation of bottom seismometers in the Borderland.

Through reduction of the earthquake data, recurrence curves, as seen in Figure III-14 , are developed. As pointed out by Allen (DES, OCS - Sale No. 35, Hearings, May 6, 1975) the historical earthquake record is too short to have statistical significance for a region as small as the Southern California offshore area. Whitcomb (DES, OCS Sale No. 35, written testimony) indicates that although there are obvious limitations to calculations of potential earthquakes from historical earthquakes, it is the only option presently open. Therefore, at this time, with insufficient geophysical data to adequately delineate the "active" faults of the Borderland, the statistical records of past earthquakes are used as an indicator of seismic activity. It should be noted that all proposed lease areas have numerous faults within and around the proposed lease areas; as presented in Section II-A an earthquake of magnitude 8 can be statistically expected once every 52 years and a magnitude of 6 could occur once every 10 years.

As a consequence of tectonic activity (faults-earthquakes-deformation), many types of environmental hazards will be activated. In the near and offshore marine environment, the following events may take place: liquefaction, landslides, submarine slides, slumping, turbidity currents, geologic structural instability, and tsunamis. With the greatest amplitudes and the longest duration of motion found in thick, water-saturated sediment areas, soft ocean bottoms represent potential zones of liquefaction. Slides, slumping, turbidity flows, and general bottom instability may all be catalyzed by liquefaction, or may be direct consequences of seismic activity. In areas where potential liquefaction sediments exist the extent to which the impact will occur is dependent on the sediment characteristics (density, porosity, shear strength, compaction potential, liquefaction potential, mineralogical composition and grain size).

If the sea floor is displaced by some mechanism, hydrodynamic factors within the water mass may produce a tsunami. It was found by Iida (1958, 1963) that for noticeable tsunami to occur, the magnitude (M) of the earthquake must be larger than 6.3 + 0.01 D (D is equal to focal depth in kilometers). If a disastrous tsunami is to occur, the magnitude must be greater than 7.75 + 0.008 D. This shows that an earthquake of at least 6.3 or larger will have to occur, to produce a potentially hazardous tsunami. Iida (1973) also points out that the studies of tsunamis in Japan (1700 - 1960) reveal that large tsunamis must be generated in deep water.

Within the Borderland, earthquakes represent a potential cause of a catastrophic oil spill either from direct movement (horizontal or vertical) or from the discussed resultant tectonic activity. Although we know of no major earthquake effects on oil operations, there are accounts of after shocks (4.6 magnitude) from the San Fernando earthquake rupturing several water mains. (DES OCS Sale #35, written testimony, Whitcomb). Damage resulting from earthquakes could be of the following:

1. Failure of structures and pipelines due to seismic shaking.
2. Shearing or bending of casing at depth.
3. Failure of structures and pipelines due to sediment instability resulting from seismic activity.
4. Destruction of oil tankers, pipelines and possible structures as a result of tsunami which is a consequence of ground displacement.

Due to the large proposed lease area in the Borderland and the high density of faults, damage to pipelines represents a high potential for an oil spill from from earthquake shaking, ground displacement and/or produced currents. Spill volumes associated with the size (ID) and length of pipeline is seen in Table III -15.

TABLE III - 15

Length/Volume Relationship of
Line Pipe

Size (inches) ID	Length Required to Hold 1,000 bbl. (miles)	Barrels Per Mile of Line
2.067	45.6	22
4.026	12.0	83
6.026	5.3	189
8.071	3.0	334
10.020	1.9	515
12.090	1.3	750
24.000	0.3	2954

From U. S. G. S., 1973.

In determining areas that might be potentially hazardous due to tectonic activity, substrate characteristics, proximity to faults, and recurrence rates of seismic activity must be taken into consideration.

Due to the contradictory environmental factors (water depth, surface and subsurface soil conditions, wave and current forces, wind forces, total equipment weight, seismic forces, and other pertinent geological, geographical, environmental, and operational conditions) design criteria for each specific site is approved by U.S.G.S. (OCS Order No. 8).

From Henyey (DES 74-90 - Increase in Acreage, 2-75, written testimony) it is indicated that in the past, no destructive earthquakes have been known to result from oil extraction operations. Ground subsidence resultant from minor earth tremors (Kovach, 1974) are known to result from fluid withdrawal. In studying the effect of oil operations on tectonic activity, Teng et al. (1972) indicated that oil field operations in Southern California have a negligible effect on seismicity, while Healy et al. (1972) have shown that fluid repressuring of the subsurface can induce small earthquakes along preexisting fracture zones in a hard rock medium under existing tectonic stress.

Allen (DES, OCS Sale No. 35, written testimony) indicates that he would not want to rule out the possibility of some sort of significant oil-production-triggered earthquake, but the historic record both in California and throughout the world both suggests that the chances of this happening are exceedingly remote.

We find that since the subject of oil-production-triggered earthquakes is of debate, the potential should be considered a possible pathway from which an oil spill or seep may occur.

B. Impact on the Living Component of the Environment: An Introduction

Oil Spills

In order to assess oil spill impacts on the biota of the Southern California Borderland, it is necessary to explore a general overview of the known and disputed facts of the subject. The base of information for this chore must come from studies reported in the literature. Only with this information, can we hope to make judgements of the impacts. As indicated below, the known information on oil spill impacts is incomplete and often ineffective, but we must indicate these weaknesses and scientific disputes and do the best we can with the information at hand. The following introduction presents an overview of (1) the fate of spilled oil in the ocean, (2) variables and general similarities of oil in the environment, (3) Santa Barbara blowout overview, and (4) a maximum and minimum spill situation the effects of which will be followed through the rest of this section. More detailed treatment, including estimation of specific impacts, follows in specific subject sections.

Fate of Spilled Oil in the Ocean

An oil slick floating on the ocean surface will change both in physical configuration and in relative amounts of chemical fractions. The rate of this change depends upon environmental factors, including wind, waves, temperature, suspended sediments, and time. The general trend is toward a reduction of the oil mass, especially its lighter fractions. The greater the intensity and quantity of the environmental factors, the greater the amount of oil reduction and usually dispersion of the oil slick. Battelle Northwest (1973) outlined the following natural factors which affect the persistence of oil: dilution, evaporation, photo-oxidation, sedimentation by adsorption on suspended particles, and microbial degradation. Certain components of the oil are soluble in water and become separated from the oil slick. The lighter and aromatic fractions of oil tend to be more toxic to organisms, but also become quantatively reduced relatively early (Evans and Rice, 1974). Anderson et al. (1973) reported as much as a 90% decrease in the total aqueous hydrocarbon concentration fraction in 24 hours with gentle aeration under laboratory conditions. They reported that naphthalenes (diaromatics) are the most toxic and water soluble fractions of oil. The uptake and release described by Anderson and Neff (1974) for naphthalenes is similar to that of the carcinogenic benzo-a-pyrene.

Variables and Similarities of Oil in the Environment

There have been several oil spills where the effect on biological communities has been recorded. Extrapolation of these effects to predict the effects of an oil spill on communities in or near our proposed lease area is difficult because of the many variables involved. What may have occurred during one spill may have little relation with occurrences of another spill at a different geographic location or time of year. The variables can be divided into the following major categories: (1) the oil itself, (2) fate of the spilled oil, (3) physical and chemical, and (4) biological.

References for the partial list of variables shown on Table III-16 come from various literature sources, (Evans and Rice, 1974; Anderson et al., 1973; Foster et al., 1971; Straughan, 1972; Swift et al., 1970, and Battelle Northwest, 1973) or are common knowledge.

Despite the multitude of variables and limitations of scientific knowledge on several critical aspects, there are generalizations regarding biotic effects of oil spills which appear to be justified on the basis of the existing literature. These are summarized below by the California State Lands Commission (1974).

> Oil spills may be responsible for lethal effects (e.g., direct chemical toxicity and suffocation), for sublethal effects (e.g., interference with chemically mediated behavior, tainting, carcinogenicity and mechanical coating), and for habitat alteration (e.g., rendering of a substrate unsuitable for settlement of planktonic larvae). Toxicity of oil is closely related to solubility in water, which decreases with molecular weight. Soluble aromatic hydrocarbons and their derivatives are the most toxic components of crude oil. Among the soluble aromatics, napthalenes appear to be highest in toxicity (Anderson et al., in press). Because of the toxicity and high solubility of low-to-medium molecular weight fractions, these chemicals are potentially the most deleterious components of crude oil in terms of ecological impact. Low molecular weight paraffinic hydrocarbons are less soluble, but may induce narcosis leading to death. Crude oil exposed to environmental weathering forces rapidly loses the low molecular weight components through evaporation and dissolution. Consequently, weathered crude is somewhat less severe in its significance to the ecosystem relative to fresh crude and refined petrochemicals of the lower boiling ranges. Equivalent volumes of refined petrochemicals (diesel and fuel oils) are much more toxic than crude oils. Residual oils are depleted in lighter (water soluble) fractions and are low in toxicity, but can have important mechanical effects on organisms and their environment. Microbial oxidation operates to reduce straight chain paraffinic components of spilled oil after a period of time, but dissolution of the higher molecular weight aromatics is very slow. Some of the latter may have carcinogenic proper-

Table III-16

VARIABLES OF OIL SPILLS AND THEIR EFFECT
ON MARINE COMMUNITIES AND ORGANISMS

A. Fate of Spilled Oil
    - dilution
    - evaporation
    - photo-oxidation
    - adsorption on particles and sedimentation
    - microbial degradation
    - solubility
    - treatment of the spill

B. Oil
    - original composition, including:
        - aromatics and diaromatics
        - carcinogenic
        - etc:
    - age
    - solubility
    - total amount
    - concentration

C. Physical and Chemical
    - amount of fresh water (salinity)
    - suspended sediment (organic and inorganic)
    - temperature
    - tide
    - wave force, period and direction
    - wind velocity and direction
    - current velocity and direction
    - geographic location and climate
    - time of year (season)
    - photo-intensity and photoperiod
    - substrate-particle size
        - chemical composition
        - stability
    - water quality
    - shape and size of cove, estuary, harbor or shoreline
    - type of beach-rock, sand, slope
    - natural or artificial barriers (complete or partial) to oil flow or wave or currents e.g: flotsam, kelp beds, bulk heads, etc.

D. Biological
    - species
    - age
    - sex
    - molting stage
    - condition and general health

Table III-16 (Cont.)

time of year, reflecting:
   spawning season
   migration
previous acclimation
size
metabolic rate
proximity to range periphery
bacterial inoculum

> ties. The environmental impact of spilled crude oil is a function of the amount spilled, the extent to which weathering depletes biologically-active components (especially aromatics), and the physical and biological character of areas affected. It remains to be conclusively demonstrated that marine biotic communities generally lack the capacity to absorb the effects (including substantial mortalities) of acute oil pollution episodes without sustaining significant permanent damage. Possible exceptions are situations where pollution is extremely widespread, or of long duration.

The lack of knowledge concerning the effects of long term low level (chronic) oil pollution on marine organisms (Evans and Rice, 1974) should be added to the above generalizations.

The effect of oil spills on biological communities have been studied in other geographical areas, but different environmental conditions render these studies to be poorer predictive tools than the Santa Barbara blowout. Other studies include the commendable efforts of the scientists at Woods Hole in their study of the spill at West Falmouth, but the material spilled there was No. 2 fuel oil, generally conceded to be far more toxic than most crude oils. The Tampico spill off Baja, California involved diesel fuel, while the Torrey Canyon spill involved crude oil, but biological damage was primarily caused by oil dispersents. The Arrow spill in Nova Scotia, involving bunker C oil, occurred in extremely cold water and climate. The 1971 collision of two Standard Oil tankers in San Francisco Bay also involved bunker C oil.

Santa Barbara Overview

During the 1969 Santa Barbara oil blowout the marine communities just north of and in an ecologically similar environment as the present lease area were studied, but much of the information coming from the various studies is extremely conflicting. The reported amount of oil spilled during the peak period varied from 500 barrels/day (McCulloch, 1969) to 5,000 barrels/day (Allen, 1969); the reported time required for the oil to reach the mainland shore varied from one day for "a light film of oil tapered off in a northeasterly direction and intersected the beach west of Carpinteria" (California Department of Fish and Game, 1969), to three days (Foster, Charters and Neushul, 1971), to six days (Straughan, 1971; Battelle, 1970).

Estimates of the damage to biological communities also varies. Everyone who considered them reported that birds were killed in large numbers, but estimates of the damage to the intertidal community varies from essentially none (Anderson et al., 1969) to 100% mortality to barnacles and surf grass at certain locations (Foster et al., 1971).

The particular set of environmental circumstances at the time of the blowout prevented the potential damage to biological communities from being as extensive as it could have been. (1) The oil did not reach shore, at least in large quantities, for three to six days after the spill. This allowed most of the more toxic aromatics to volatize and damage to the intertidal community was not as extensive as it could have been (Foster et al., 1971). (2) According to Battelle Northwest (1970) at approximately the same time the oil finally reached shore, there was some reduction in the amount of oil and gas flow from the blowout, although the flow increased again several days later. (3) The unusually heavy rains of the winter of 1969 brought unusually large amounts of sediment into the area acting as a sinking agent and prevented much of the oil from reaching shore (Kolpack, 1971). (4) The strong winds six days after the blowout scattered the surface oil and may have washed some oil into the sea, thus reducing contamination of the intertidal zone (Straughan, 1972). (5) The flood also brought flotsam and jetsam into the area which adsorbed oil (California Department of Fish and Game, 1969). (6) Gains (1970) in Straughan (1972) reported oil was prevented from reaching shore by a natural current barrier, along which oil and other debris collected. (7) Kelp beds withheld oil and prevented massive contamination of the beaches (Battelle, 1970). (8) The intertidal sandy beach population was at a natural low due to winter erosion of sand away from the beaches (Trask, 1971 and Straughan, 1973). (9) Little detergent was used.

Because of the environmental similarities of our proposed lease area and that of Santa Barbara, the effects to particular communities will be detailed under the appropriate sections, but a general overall summary of the biological effects from the blowout follows: According to Foster et al. (1971a) and Straughan (1971) biological damage was not widespread. Much of the damage to intertidal areas corresponded to sand movement, probably from storm damage (Foster et al. 1971b). cimbert et al. (1973) concluded that the blowout had less effect on intertidal marine organisms than did sand movement and substrate stability. Sea birds, especially swimming birds, had the highest mortality of any group. The only extensive mortality reported to marine organisms occurred in the upper rocky shore intertidal to acorn barnacles (*Chthamalus fissus*) and eel grasses (*Phyllospadix torreyi*). Breeding rates of barnacles and mussels and larval settlement of barnacles were temporarily inhibited (Straughan, 1971). An unusually heavy winter rainfall at the time of the spill, which reduced salinities, prevented more definitive statements concerning the effects of oils on the biological communities. It was difficult to separate the effects of these two factors. Straughan noted factors unique to the Santa Barbara accident: the long history of natural oil seepage in the Santa Barbara Channel, the heavy winter run-off mentioned above, and possibly increased pesticides in the channel.

According to Kanter et al. (1971) Santa Barbara crude oil is relatively insoluble in seawater and contains a very low percentage of the toxic aromatic compounds. The amount of damage from the toxic fractions of the oil may not have been extensive under any conditions. Damage may be primarily due to smothering.

The time required for a biological community, particularly a benthic community, to recover to its original pre-damage condition is an interesting question. The time required for resettlement of organisms in an area is less than the time required for organisms to reach sexual maturity and begin to reproduce (biological recovery). It is more realistic to consider the establishment of a viable reproducing population as the criterion for normal pre-damage conditions. Because the ocean temperatures of the Southern California Borderland are cooler than those of the Gulf of Mexico, sexual maturity of ecological or phylogeneticly similar species takes significantly longer in California waters (Gunter, 1957). According to Straughan (1971) it requires goose neck barnacles, an important component of intertidal areas, five years to reach sexual maturity.

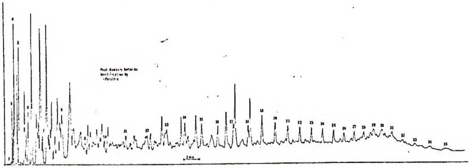
For thousands of years the Southern California Borderland has had numerous sites of natural oil seepage (California Division of Oil and Gas, 1972). There is evidence that organisms of the area may have even developed some tolerance for oil. Kanter et al. (1971) found evidence that intertidal mussels (*Mytilus californianus*) from Coal Oil Point were more tolerant to exposure to Santa Barbara crude oil over a two month period than *M. californianus* from areas where there was no adjacent oil seepage. This apparent tolerance varies from species to species and is not a general condition for all species (Straughan, personal communication 1975). The relative composition of the various fractions of seepage varies with location even within the Borderland (California State Lands Commission, 1974).

In connection with an oil seep identification study O'Neal (personal communication, 1974) indicated that the composition of natural seeps varies from highly viscous asphalt-like tars through gas. Generally, however, natural seeps have less of the more toxic low molecular weight fractions than crude oil. Crude, after several days of floating on the ocean surface becomes indistinguishable from seep oil with respect to lower molecular weight fractions. This also is generally true of seep oil from Coal Oil Point. There is apparently no significant difference in the aromatic content of seep and crude oils of the area (written testimony of Dames & Moore, 1975). The greater toxicity of crude oil relative to most seep oil is, therefore, marginal and probably will not cause much greater biological destruction on a per unit basis. When considering a large spill, however, the total destruction caused would increase roughly in proportion to the increased volume of the spill.

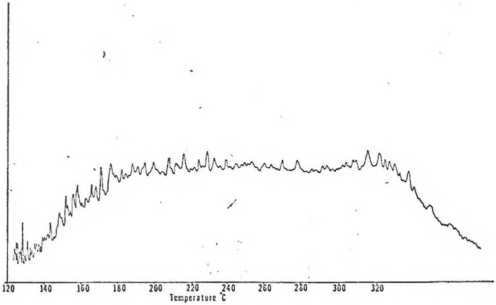
A comparison between crude oil from Rincon Trend and Coal Oil Point is presented in Fig. III-16. Unfortunately, this characterization was

Figure III-16

A - Gas chromatogram of fresh oil from the Dos Cuadras Field, offshore on the Rincon Trend, in the Santa Barbara Channel.



B - Gas chromatogram of fresh oil from natural seepage in the Coal Oil Point area of the Santa Barbara Channel.



From Straughan (1973)

based upon separation by column chromatography (alumina, pentane) of a fraction containing only the less toxic saturated, non-aromatic hydrocarbons. Organisms unaffected by exposure to the tar-like natural seep oil may not necessarily be unaffected by exposure to freshly spilled natural crude.

As is evident on Graphic 12, the Santa Barbara Channel area (north of our lease areas) has far more natural oil seeps than our proposed lease areas. The tolerances developed by inhabitants of Coal Oil Point may not have been developed by organisms in our proposed lease area. This was, indeed, shown to be true for the common intertidal mussel *Mytilus californianus* (Kanter et al., 1971).

In preparation of the Georges Bank Petroleum Study, MIT's Offshore Oil Task Group (1973) identified several pathways by which crude oils can exert a damaging effect on plants and animals.

a) any disruption at or below cellular level is considered to be a cellular effect.

b) any disruption above the cellular level dealing with biochemical processes is considered to be a physiological effect.

c) any disruption of instinctive and/or voluntary control is considered to be a behavioral effect.

They then defined five responses which are elicited by these three types of effects:

1) lethal toxicity,
2) sublethal disruption of physiological or behavioral activities,
3) the effects of a direct coating by oil,
4) incorporation of hydrocarbons in organisms which cause tainting

and/or accumulation of hydrocarbons in food chains; and

5) changes in biological habitats.

We have taken these responses and applied them to three broad categories of spills and the ecosystems they affect in Table III-17.

In summary: Santa Barbara blowout studies are the best we have to predict oil spill impacts when one occurs as the result of the present proposed lease. In spite of the work done on this spill, many questions remain unanswered. More detailed qualifications of these impacts will be estimated below.

Scenarios of Oil Spills

As indicated above, quantification of impacts, biological, recreational or otherwise, is nearly impossible. Too many variables (Table III-16) exist and usually not enough is known about the resources impacted. As an example of the variability which usually exists in biological populations, the following dilemma is quoted from Foster (1974):

> To estimate the average number of barnacles per unit length of shore, individuals were counted within randomly located strips at Loon Point (Station F, Foster et al. 1971b). Five strips, .82 feet wide by 6.56 feet long (.25 x 2 m) oriented perpendicular to the shore in the high intertidal, were counted giving values of 25, 74, 76, 154, and 105,000 barnacles per strip.

Foster continues with the understatement:

> The variation is extremely high and it was obvious that estimating the mean abundance would require detailed field surveys beyond the scope of this report. Therefore, to assure a conservative error, I used the median abundance of 76 barnacles per strip.

If even 1% (let alone the 20% reported above) of the area were occupied by 105,000 barnacle strips, it is obvious the 76 individuals per plot

Table III-17

Source	Lethal Toxicity	Sublethal Effects	Coating With Weathered Oil	Incorporation of Hydrocarbons into Food Webs	Changes in Habitat
Massive Oil Spill	Open Gulf Shoreline Estuary/ Wetland	Open Sea Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Open Sea Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland
Small Oil Spill	Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Estuary/ Wetland	Estuary/ Wetland	
Chronic Dis-Charges and Minor Spills	Shoreline Estuary/ Wetland	Open Sea Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland	Shoreline Estuary/ Wetland

Explanation of Terms:

Massive Oil Spill: Several hundreds to thousands of barrels
Small Oil: Fifty to a few hundred barrels
Chronic Discharges and Minor Spills: Amounts small but very frequent or continuous
Lethal Toxicity: Interrupts physiological processes at cellular or organ level
Sublethal Effects: Adverse effects on physiology of growth and reproduction and on instinctive and voluntary behavior
Coating with Weathered Oil: Large patches of tarry material which has already lost much of its toxicity due to biochemical oxidation, vaporization
Changes in Habitat: Lasting for several years, longer than the spill/clean-up period.
Shoreline: Intertidal to exposed beach; not including estuaries, bordering wetlands.

figure would be completely erroneous.

The impacts from two hypothetical oil spills will be considered throughout this section. (1) A large spill was modeled after the Santa Barbara blowout, but there are three cases regarding the fate of the oil, each case potentially affecting different resources. (2) A smaller spill having the potential of originating from a drilling mishap, pipeline rupture or barging accident.

The large spill scenario is a rough estimation of the near maximum impacts resulting from a large spill. The many variables (Table III-16) affecting the fate and impact of an oil spill make it extremely difficult, if not impossible, to predict the exact outcome of a large spill. We further realize that there are many possible scenarios with fates and impacts between the three cases outlined below.

Large Spill - The spill will involve a total of 4.2 million gallons (100,000 barrels) of oil spilled over a 61 day period. The rate is 210,000 gal. (5,000 bbl.) per day for the first 11 days (2.31 million gallons or 55,000 bbl.) followed by a decrease to 37,800 gal. (900 bbl.) per day for the remaining 50 days. The figure of 100,000 barrels, rate and duration is similar to that reported by Allen and cited in Battelle Northwest (1970) during the Santa Barbara blowout. The largest spill reported in the Gulf of Mexico is 160,000 barrels (U.S.G.S., 1971), so although our hypothetical spill would be bad, it is not the maximum amount possible.

Conversely, the official U. S. Geological Survey estimate of oil spilled during the Santa Barbara blowout was 10,000 bbl. If this were true, the Santa Barbara blowout, in comparison with other OCS spills, would be far from a maximum OCS spill, and not a realistic spill from which to model a high case scenario. Because of the wide area covered and length of time that oil flowed during the Santa Barbara spill, it is more realistic to consider it as a severe near maximum spill and to use the higher spill figures of Allen.

Case 1 - The spill occurs from a platform 3 to 4 miles from shore directly off a rocky shore intertidal area which has also been classified as an Area of Special Biological Significance. Two drift velocities will be assumed to give a range. The maximum case follows the more extreme situation when an oil slick travels directly to shore at between 0.7 mph to 1 mph (5% speed of a 20 mph wind) and reaches shore in about 3 or 4 hours. This velocity is slower than the 3 to 4 knots implied by Battelle Northwest (1970) when they cited a Weather Bureau meteorologist who estimated that downwind oil slick drift ranged from 10 to 20 percent at the surface wind velocity and stated "...instances of skin layer shear were noted with surface oil moving rapidly past nearly stationary free floating debris suspended less than half an inch below the water surface." The second velocity, a high minimum, assumes a 0.45 mph slick velocity (3% speed of a 15 mph wind) with the slick reaching shore in 6.7 to about 9 hours. This is comparable with the experience in the Torrey Canyon incident during which the oil movement rate averaged 3.3 to 3.4 percent of the wind velocity. The amount of time winds reach a velocity of 15 or 20 mph varies with season and distance from shore. Summers are predominated by stronger winds from the northwest and west. There is a significant increase in wind velocity offshore. Wind velocities around San Miguel Island are greater than 13 mph about 45% of the time during July (Kimura, 1975). Wind velocities along the mainland coast are less than 15 mph the vast majority of the time during both summer and winter (Section II.B.4.). The islands most vulnerable to oil slicks are the San Miguel, Santa Rosa, Santa Cruz group and, to a lesser extent, Santa Barbara Island. Winds of 15 or even 20 mph do occur in the Southern California Borderland and the scenario is, therefore, based on these near maximum potential impact cases.

Although the high winds required to rapidly transport the oil slick to shore reduce its volatile toxic fractions faster than under calm seas, the detoxification would be less than if the slick drifted on the ocean for several days before it reached shore.

Although this scenario uses a discharge rate to obtain oil masses at various times after the initial spill, through the lack of a better method, the oil mass spreading was determined by equations that deal with spill volumes rather than rates of discharge. These equations used to calculate the spreading of oil over calm water do not consider physical movement (wind, waves, current, and tides) in the calculations.

Tables III-18 and III-19 derived from Fay's (1971) and Blokker's (1964) equations, give the areas over which the oil mass volume may spread.

Since Fay's and Blokker's equation do not consider ambient movement or discharge rate it is probable that the slick lengths, which were previously considered maximum, are conceivable minimum slick sizes due to the nonconsideration of local physical forces within the equation.

Table III- 18

Spreading of Oil*

	Area		Diameter	
Volume (gallons)	Sq. Meters	Sq. Miles	Meters	Miles
3.50×10^4	3.91×10^6	1.51	2.24×10^3	1.39
2.10×10^5	1.50×10^7	5.79	4.38×10^3	2.72
2.61×10^6	9.91×10^7	38.26	1.12×10^4	6.98
4.20×10^6	1.42×10^8	55.82	1.35×10^4	8.36

* Calculated from Fay (1970).

Table III-19

Spreading of Oil, Time Dependent*

		Area		Diameter	
Volume (gallons)	Time (hrs)	Sq. Meters	Sq. Miles	Meters	Miles
3.50×10^4	4	9.58×10^5	0.37	1.09×10^3	0.68
2.10×10^5	24	1.01×10^7	3.90	3.59×10^3	2.23
2.61×10^6	264 (11 days)	2.59×10^8	100.	1.82×10^4	11.31
4.20×10^6	1464 (61 days)	1.10×10^9	426.	3.75×10^4	23.30

* Calculated from Blokker (1968).

Fay et al. (1971) proposed that the maximum slick area be related to the volume of the spill by the following dimensional formula.

$$A\ (m^2) = 10^5 \quad v\ (m^3)^{\cdot\ 3/4}$$

A = area
m = meter
v = volume

Fay found that this formula compared well with some recently (1971) summarized field observations.

From Berridge et al. (1968) the following equation from Blokker (1964) is given:

$$\frac{(r_t{}^3 \quad r_o{}^3) \quad {}_w}{3v(\ {}_w \quad {}_o) \quad {}_o} = K_r t$$

where r_o, r_t = slick radius (cm) initially and after time t sec. Assume $r_o{}^3$ can be neglected in comparison with $r_t{}^3$.
v = volume of oil(cm^3)
t = time of spreading(sec)
w, o = density of water and oil respectively (g cm^{-3})
K_r = a constant for a given oil

The "Blokker" constants, K_r, are derived from the slope of the curves, of the variation of the radius $(r_t{}^3 - r_o{}^3)$ with time as oil slick spreads.

The Blokker constants, seen below, were derived from the slope of curves of slick spreading as a function of time for various crude oils.

Crude Oil Properties

Crude oil	K_r (about 9°C)	Specific gravity
Libyan (Brega)	1085	0.829
Iranian Heavy	750	0.867
Kuwait	1480	0.869
Iraq (Kirkuk)	975	0.845
Venezuela (Tia Juana Medium)	1340	0.869

The Blokker constant and oil and water specific gravities arbitrarily used are 1000 and 0.85 and 1.00 respectively. The data from the two tables, derived from Fay's and Blokker's equations, agree fairly well for each specific spill volume except for the fourth case in each table. Therefore, it is inferred that the maximum distance an oil volume will spread, on calm water, for each of the oil spill volumes given in Tables III-18 and III-19 is correct.

Murray et al. (1970) indicates, "For a given oil spill incident the current speed largely determines the size a slick will reach". It is further indicated that high discharges may elongate slicks and that high current speeds (Chevron incident observed) minimize the slick size and enhance the rate of oil diffusion.

From Murray's analysis of the Chevron spill (March 1970) it is possible to determine the slick length and width of oil from a continues source as a function of the rate of oil discharge and ambient currents. From one of Murray's graphs, Figure III-17, a spill rate of 2500 barrels (105,000 gallons) per day with current velocities of 10, 25 and 50 cm/sec (0.22, 0.56 and 1.12 miles/hr.), is found to produce slick lengths of 300, 120 and 58 km (186, 77 and 36 miles). If it is possible to extrapolate Murray's analysis for the above current speeds, at a discharge rate of 5000 barrels/day (210,000 gallons/day), the following slick lengths would be obtained: 1166, 466 and 281 km (725, 290, and 175 miles). The comparable slick widths are given below.

	2500 bbl/day	5000 bbl/day
10 cm/sec	19.2 km (11.9 miles)	38.40 km (47.7 miles)
25 cm/sec	7.7 km (4.78 miles)	15.4 km (9.6 miles)
50 cm/sec	3.8 km (2.36 miles)	6.7 km (4.16 miles)

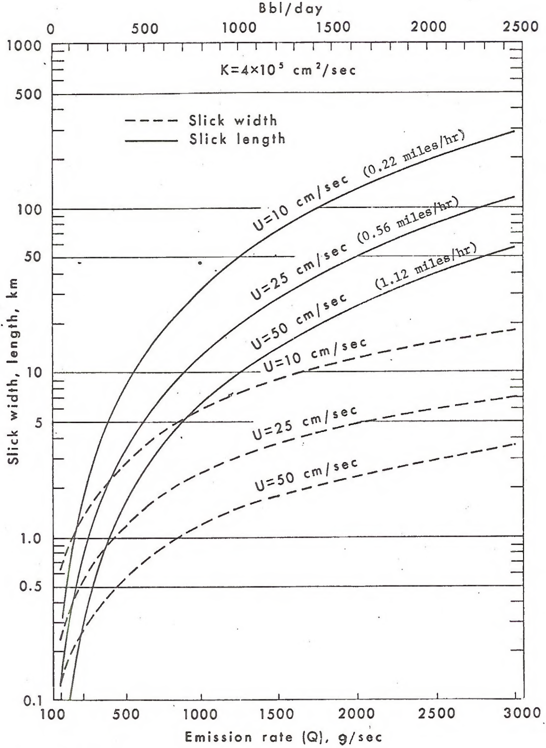


Figure III-17 Slick width (W) and slick length (L) as a function of rate of discharge (Q) for various values of current speed (U). (Murray et al., 1970)

Since the above discharge rates are extrapolated and at the extreme end of Murray's curves, the slick lengths given are only considered a potential situation.

Case 2 - is a situation with negligible wind and current velocity which allows the oil to simply float and spread on the water for over a week before it finally goes ashore. As with the Santa Barbara blowout the oil covers 500 square miles of open ocean, and does not reach shore until the 12th day when damage to the intertidal area is at a near minimum. A 500 mile oil slick would be a very thin film with scattered patches of heavier oil (Allen, 1969).

Case 3 - This spill occurs during a period of maximum land derived sediment inflow which causes maximum oil settlement to the bottom relatively near the source of the spill. We estimate that 30% of the oil spill volume will settle to the bottom. In terms of volume, this is 63,000 gal. (1,500 bbl.) after one day, 690,000 gal. (16,500 bbl.) after 11 days, and 1.26 million gallons (30,000 bbl.) after 61 days. We assume there is little current and wind, the oil spreads in the shape of a circle, and sinks to cover an area of bottom equal to that of the area covered by the surface slick in Case 1. The area of bottom covered and diameter of the circle is shown in Tables III-18 and III-19.

Small spill - This is a spill of 500 barrels resulting either from a tanker accident, pipeline rupture, or platform accident. Rather than describing specific cases involving oil movement of various kinds, we will leave this a generalized spill which can be applied to any circumstance.

Pipeline Burial, Drilling Mud and Cuttings Discharge

Dames & Moore (1973), working relatively near to our proposed lease areas estimated the impact on kelp beds and beach communities due to pipeline burial by blasting, jetting, and installation of rip-rap (anchoring unburied pipelines with rock, concrete blocks or concrete bags).

> Between the intertidal and inner edge of the kelp bed, sediments are thin and rip-rap installation or blasting would be required. Sediments become thick in the kelp beds, and decrease again beyond 125 foot depth. Presumably, the pipeline could be buried by jetting within the kelp bed.
>
> Blasting is clearly more detrimental than jetting in terms of short-term adverse effects, but neither has significant long-term impacts. The biological environment would, in the long run, return to a condition similar to that before construction. Although causing a redistribution of sediment (and hence redistribution of organisms) over a limited area, the installation of rip-rap would certainly provide additional habitat for many organisms including kelp, lobster, abalone, and game fish. The area would appear less "natural" than it had been previously, but biological conditions favoring commercially and recreationally important species would be enhanced.
>
> The pipelines would be hydrostatically tested with sea water (obtained near the surface of the ocean) prior to being placed in operation. After testing, the water would be disposed of at the platform or by sub-surface injection at the on-shore facility. Small volume leaks along the pipelines during testing would have negligible impact. If it occurred, the accidental discharge of a large volume (7,500 barrels) of salt water would have appreciable effect only if it occurred on land. Vegetation in the immediate vicinity would be adversely affected, perhaps lost. There would be no significant long term adverse effects.
>
> The use of heavy equipment on the beach during construction would crush large numbers of upper beach epifaunal species such as sand hoppers (*Orchestoidea*). Infauna would be less affected. If fuel were spilled on the beach, it could be toxic to intertidal animals and algae. Repopulation by sand beach animals would be rapid; probably on the order of a few weeks.

> The oil temperature is expected to be between 105 and 107° F at the platform; it will have cooled to around 100° F or less by the time it reaches the shoreline. The oil flowing from the treatment facility to the offshore loading terminal is projected to be 80-90° F (95° F maximum). Assuming an ambient temperature of 50° F, the skin temperature of the pipeline has been calculated, by others (Esso Production Research), to be 55° F. In nearshore waters, it is unlikely that a skin temperature even as high as 10° F above ambient would prevent the growth of fouling organisms (e.g. barnacles, tubeworms and bivalves).

The areal impact due to jetting would be limited to less than 40 meters of bottom, while that of blasting would be only slightly larger, the exact distance being hard to predict. The time for the area to recover, as indicated above, would be the time required for the destroyed sessile community member species to reach sexual maturity and reproduce. Kelp require one to two years to mature. Dames & Moore estimate that "recovery" of most organisms would be rapid, within months to a year .

In other areas it can be assumed that the effects of pipeline burial in offshore areas and bays will be qualitatively similar to those ascribed to channel dredging, but not as severe because:

a) the physical dimensions of the excavation are much smaller,

b) the digging of a pipeline canal, or burial of a pipeline is a one-time event, whereas channel dredging is more or less continuous.

It is tentatively assumed that the effects of drilling muds and cuttings discharges are also related to those of dredging, specifically, turbidity and smothering. Of further note is the presence of chromium in many marine drilling muds as the organic complex, (ferro) chrome lignosulfonate. Overboard loss or discharge of drilling fluids would introduce some of this chromium into the marine environment. On a weight basis, this element is present in unweighted commercial lignosulfonate drilling mud components at a concentration of about 12ppt. Required sea water additions to the mud concentrate reduce this value to less than 4ppt. -- the approximate concentration of chromium in discharged drilling mud. In addition, dilution/dispersion effects associated with overboard discharge in Pacific waters would be considerable. Furthermore, sodium lignosulfonate has largely replaced cromium lignosulfonate in commercial muds used in Pacific waters (see Section III. A.1.a.). Although data relating to toxicities of organic compounds containing chromium are scarce, recent work suggests that chrome lignosulfonate, in moderate to strong dilution, is relatively harmless. While readily soluble in sea water, the compound apparently dissociates very little. If inorganic chromate is also present in the drilling mud, however, oxidation of the chrome lignosulfonate occurs, evolving a new organic chromium complex (Skelly and Dieball, 1970). The nature of this new phase is not well understood.

Jessen and Johnson (1963) discussed physical adsorption and ion exchange relations between chrome lignosulfonate and clay components of drilling muds. Their work indicates a strong tendency towards adsorption of all chrome species present in the muds tested. Ion exchange occurred predominately in the high-sodium bentonite clay types. Both transfer mechanisms effect the removal of chrome components from the water column with subsequent deposition as clay sediment. Once on the sea floor, chrome lignosulfonate is fairly resistant to biodegradation, however, certain benthic invertebrates are known to concentrate trace amounts of various heavy metals over extended time. The possible role of drilling mud chromium additivies in this phenomenon should not be ignored. Recent industry tendencies toward maximum recovery of chemical additives will minimize potential hazard to life of species while relevant experimental data accumulates. Also, as mentioned above, sodium lignosulfonate has largely replaced chromium lignosulfonate in commercial muds used in Pacific waters. Barium in drilling muds also represents a potential threat to marine life. This is discussed in connection with benthic communities (Section III.C.2.).

In general the effects of pipeline burial and drilling mud and cutting discharges are:

a) dredging nearshore areas where land pollution has occurred for many years, numerous pollutants will be resuspended in the water column. These may include organic matter which will increase BOD and decrease dissolved oxygen, toxic heavy metals and pesticides which may exert toxic effects before gradually being reincorporated into the sediments.

b) dredging in areas of hard bottoms where biotic communities have evolved to take advantage of such conditions and are adapted for attachment to a hard substrate (sponges, soft corals, kelp beds and other seaweeds, sessile molluscs), will eliminate suitable sites for attachment in the path of the operation. These effects will not be permanent and resettlement and reproduction by many of the species will occur before the substrate can become compacted again, a process involving at least several years.

c) both pipeline burial and mud/cutting discharges will produce a smothering effect on the burrowing and attached benthos where the material gradually settles as a layer of significant thickness.

d) increased turbidity will occur at all marine sites where pipeline burial and mud/cutting discharges takes place. The fine particles causing the turbidity can clog the respiratory organs and filter-feeding mechanisms of many marine animals.

e) pipeline burial in coastal wetlands, uplands and islands will displace many species of wildlife during operations due to noise pollution and the physical presence of construction machinery. This disruption will terminate as soon as construction is completed. The effects of pipeline burial in wetlands can have a substantial impact of one to many years duration through devegetation, disruption of substrate, and alteration of drainage patterns. The exception may be sea lions and other Pinnipeds which possibly will not return to their island breeding sites if human activity occurs too close.

C. Impact on Biota of the Open Bight Region

Impacts in the open California Borderland ecosystem will result from accidental loss of debris, discharge of drill cuttings, sand, drilling fluids, the burial of pipelines, and the accidental spillage of oil or other toxic materials. Oil spills could originate from a variety of sources (e.g., pipeline rupture, blowouts, fires or explosives, and barge or transportation accidents) and therefore a wide range of spill volumes and locations must be considered.

It must be recognized at the outset that oil spills probably represent the most severe threat to biota, but various fractions of crude oil present greater or lesser threats. The discharge of large amounts of formation water (oil field brines) would also be a significant long-term source of hydrocarbons to the marine environment. The natural (chemical, physical and bacteriological) degradation of crude oil is a complex and not well understood process. Additional complexities, such as local concentrations of various hydrocarbon fractions and the different effects of these concentrations on different species are concomitant with the degradation process. Much of the knowledge of these factors has been obtained through laboratory studies, which can be poor analogs for the natural environment.

On the other hand, field observations of effects after large oil spills in the environment have been largely confined to evaluation of visual evidence. While these might give a picture of the immediate effects of a spill, the non-visual, long-term and sublethal effects upon the biological community can escape notice without accompanying detailed chemical and physiological analyses. Therefore, the only tenable conclusion that can be drawn in many cases is that the effects of oil pollution on the organisms studied cannot be detected with the methods employed.

A final complication in the analysis of the effects of an oil spill is the timing of the spill itself. Temporal variations in the abundance of marine organisms and seasonal cycles of reproductive and developmental stages result in a wide range of numbers of organisms affected in a given area as well as a variety of sensitivities to a given spill.

1. Impact on Pelagic Marine Life

Pelagic marine life includes a broad spectrum of organisms from all trophic levels and includes the phytoplankton, zooplankton, nekton, demersals, and pelagic seabirds. See Section III.D.3. for a discussion of impacts concerning the pelagic seabirds.

a. Impact on the Plankton

Impacts that may be anticipated to have an effect on plankton will result from accidental spills of oil (and associated use of emulsifiers) and other toxic materials, discharge of drilling fluids and formation waters, and burial of pipelines. The reader may see Sections II.E.1 and 2. for a description of plankton in the area.

After an oil spill has occurred, that which has not evaporated, been carried ashore, or cleaned up will float at the surface for a time and eventually be dispersed as minute droplets in the water. In addition, certain components of crude oil are slightly soluble in seawater. In each of these three phases (floating, droplets, solute) the oil has the opportunity to damage marine organisms and/or enter the marine food web. The organisms most immediately and drastically affected are those which are found in close proximity to the sea surface.

Spooner (1969) noted that plankton collections following Torrey Canyon showed damage to minute plant cells of the order Prasinophyceae which float at the surface. A high proportion of pilchard eggs, which also float, were dead and there was a local shortage of pilchard larvae. Spooner was unsure whether this damage was done by oil alone or by oil and the emulsifiers which had been used to disperse the oil.

According to Mironov (1971), cell division in phytoplankton was delayed or inhibited by crude oil concentrations ranging from 0.001 to 1000 ppm. Boesch (1973) supports this result by stating "...that petroleum hydrocarbons, even those not soluble enough to be directly lethal, may inhibit photosynthesis for a short time and under the proper conditions." He reports the conditions as being exposure to petroleum hydrocarbons at greater than 50-100 μg/l (i.e. .05-.1 ppm) according to Gordon and Proust (1972).

Hufford (1971) noted laboratory studies which indicated that oil can affect phytoplankton after several days exposure. He cited laboratory experiments in which oil products in sea water inhibit cellular division and cause death in phytoplankton. Apparently, cellular membranes were damaged by the penetration of hydrocarbons and this led to the extrusion of the cellular contents. During a study of the effects of the Santa Barbara spill, however, Oguri and Kanter (1971) found no conclusive evidence of an effect in phytoplankton community productivity that could be attributed directly to the oil spill. Individual experiments indicated, however, that the use of dispersants may have resulted in marked reductions in productivity. They theorized that the longevity of any such effect would depend on the currents and rate of dilution, as well as the type and quality of the dispersant. No evidence was found in the literature that spilled oil enters marine food chains via adsorption or absorption by phytoplankton and subsequent ingestion by grazing herbivores.

Straughan (1970, as cited by Dames and Moore, 1975) indicated that plankton after the Santa Barbara spill were probably not affected by the toxic components of the oil at sea since oil on the sea surface is influenced by wind and currents, while the plankton are only transported by the currents. Therefore, they would be moving at different rates and the plankton would not be exposed to the oil for a long time period. However, the effects on the surface neuston communities would be more severe since they would come in direct contact with the oil. Although the neuston was not sampled in the study of the effects of the Santa Barbara spill, Straughan (1971) states "...it is difficult to envision how these organisms could not be affected by oil."

Although the workers who reported on the phytoplankton (Oguri and Kantor) and zooplankton (McGinnis) recognize the shortcomings of their methods and the lack of previous adequate background data to compare their results in the report edited by Straughan (1971), Connell (1973) in a critique of the report states that the shortcomings of the methods did not influence the overall assessment of little damage to the marine environment in Santa Barbara Channel. Connell (1973) concludes that "the plankton...were sampled and reported in such a way as to make it impossible to decide whether there was or was not an effect of oil."

The Massachusetts Institute of Technology (MIT) Offshore Oil Task Group (1973) concluded after an extensive literature survey that phytoplankton sensitivity to petroleum products will vary over a wide range.

A few species are sensitive to concentrations of soluble aromatic derivatives of crude oil as low as 1 ppm. However, most species are unharmed by concentrations of up to 100 ppm or higher.

Crude oil toxicity studies to phytoplankton and other marine vegetation were conducted by Shiels et al. (1973) over a one year period from May, 1971 to June, 1972 in the Valdez area of Prince William Sound, Alaska. The various species of marine algae were tested for effects from Prudhoe Bay crude oil in concentrations of 0.003-10 ppm, or the expected concentration range from treated tanker ballast water discharge. Some of the results are reported below as taken from Shiels et al. (1973).

"The concentrations of crude oil in seawater necessary to cause a specific degree of photosynthetic inhibition apparently change seasonally depending on physical and chemical factors and on the species composition and relative abundances. During June a 50-percent inhibition to phytoplankton photosynthesis occurred at approximately 2.0 ppm crude oil.

Crude oil in very low concentrations in seawater stimulated phytoplankton photosynthesis over short incubation periods during December, April and June. The photosynthetic rate of June phytoplankton exposed to a concentration of about 0.003 ppm crude oil was more than double the rate for phytoplankton in seawater containing no oil.

Crude oil in treated ballast water appeared to be about one-tenth as inhibitory to photosynthesis as fresh crude oil when tested on phytoplankton collected in June.

The effects of temperature on oil toxicity to phytoplankton were varied. The temperature optimum for photosynthesis differed between experiments. Phytoplankton treated with crude oil showed maximum photosynthesis (light uptake) at 5°C during March, 10-15°C during April, and 20°C during August at crude oil concentrations between 14 ppm. The patterns for the oil-contaminated samples did not follow that of the controls. During March the oil-treated samples showed decreased photosynthesis with increasing temperature controls indicated an optimum temperature for photosynthesis at about 10°C. In contrast, during April the oil-treated samples showed a maximum rate of photosynthesis at 10-15°C compared to a 10°C optimum for controls.

The rate of light intensity in oil toxicity to phytoplankton was examined. At high natural-light levels, crude-oil toxicity appeared to be acute. Phytoplankton exposed to about 5.5 ppm crude oil showed a 65-percent reduction in photosynthesis at full light intensity (maximum of 0.89 ly/min), although phytoplankton exposed to the same concentration of crude oil at one-fourth this intensity showed only 20-percent reduction. A similar pattern was observed during tests with phytoplankton from a contrasting marine environment (Savannah, Georgia) that had been subjected to the same crude oil.

The relative species composition in a natural phytoplankton population may be altered by crude oil, resulting in a decrease in the abundance of some species and an increase in others. This effect is apparently dependent upon the amount of oil present. During May *Phaeocystis pouchetii* cells more than doubled in number after a 48-hour exposure to a crude oil concentration of 10 ppm (0.01 ml oil/added liter). In contrast, the number of *Thalassiosira nordenskioldii* cells was reduced about 75 percent."

Little information has been found concerning the effect of crude oil on the zooplankton. Hufford (1971) cited one experiment which showed accelerated death of zooplankton exposed to diesel oil (0.1% for 5 to 60 minutes) as compared to non-exposed zooplankton. Mironov (1971) stated that some copepods are sensitive to 1 ppm suspension of fresh or weathered crude oil and diesel fuel. Zooplankton have been observed to ingest spilled Bunker C oil particles, however, with no apparent effect. Members of the Operation Oil Task Force (1970), studying the effects of spilled Bunker C from the tanker Arrow in Chedubucto Bay, Nova Scotia, observed that many copepods in the area had apparently ingested small oil particles and 2.4% Bunker C was found in the feces of one species. They noted that animals containing smaller oil particles voided these within 24 hours and showed no signs of distress.

A recent study by Lee (1975) on the effects of petroleum hydrocarbons on calanoid copepods and several other representatives of the zooplankton provided some interesting results. Copepods, euphausiids, amphipods, crab zoea, ctenophores and jelly fish from the coasts of California, British Columbia and the Arctic rapidly took up various hydrocarbons in seawater solution. Uptake was linear for 24 hours with no further increase in stored hydrocarbons after that time. The crustaceans (copepods, euphausiids, amphipods and crab zoea) metabolized the hydrocarbons but not the ctenophores or jelly fish. Up to 22×10^{-4} μg of benzpyrene was ingested by the copepod *Calanus plumchrus* (occurs in Gulf of Alaska waters), while transfer of this copepod to fresh seawater resulted in the discharge of most benzpyrene with less than 1×10^{-5} μg remaining after 17 days. Where depuration was continued beyond 17 days, no further hydrocarbon loss was observed. Another copepod *Calanus hyperboreus* from the Arctic took up 11x10^{-4} μg of ^{3}H-benzpyrene and after a 28-day depuration experiment still showed the presence of benzpyrene although again less than 1x10^{-5} μg.

That zooplankton can continue normal activities with no apparent harm, could be quite important to the marine food web. The zooplankton can be eaten by small fishes and filter-feeding organisms while carrying the oil in their guts. The fish and filter-feeders may in turn be eaten by larger predatory animals, establishing the potential for a classic example of biological magnification of a potentially harmful or toxic compound. Blumer (1973) as stated by R. C. Clark (1973) said the hydrocarbons contained in the zooplankton upon which the basking shark fed had passed through the digestive tract without fractionation or structural modification. These hydrocarbons were deposited in the shark's liver. A similar effect might be possible if other toxic materials such as diesel fuel, solvents, or heat exchanger fluids were spilled during handling or as a result of platform damage.

The preceding discussion includes only the results of massive, infrequent spills. Oil in the environment also comes from numerous small spills. Statistical evidence exists (see Section III.A.) that small spills of fractions of a barrel to 50 barrels occur on the order of a thousand times per year in the Gulf of Mexico. The problem of determining potential impact from chronic, low-level spillage is difficult. Virtually none of the reports which we were able to obtain, of scientific investigations on oil spillage, addressed the effects of low-level, continuous spillage in offshore water. There are numerous continuous and discontinuous oil seeps in the Southern California area which have been in existence for thousands of years (California Division of Oil and Gas, 1973). Estimates of the volume of oil seeped range from 11-160 bbl/day for the Coal Oil Point seeps (Allen, 1969 as cited by Straughan, 1971) to an overall estimate of 100 bbl/day for the whole Southern California Borderland area (Mikolaj, Allen and Schleuter, 1972). The fact that the area is highly productive may indicate no long term effect on the plankton. However, it is unknown what the productivity of the plankton in this area would be without the natural seepage.

It is difficult to assess or predict potential damage of chemical pollution to one group of organisms, i.e., plankton, but it seems appropriate to discuss the problem at this point. A few scientists have offered cautious speculation. Another view is taken by Blumer (1969) who has stated: "...we are rather ignorant about long-term effects." Blumer (ibid) then points out that hydrocarbons are taken up into the food chain, and through the process of biological magnification can become concentrated in marine species used by man for food. He stated, "One consequence will be the incorporation into food of materials which produce an undesirable flavor. A far more serious effect is the potential accumulation in human food of long-term poisons derived from crude oil, for instance, of carcinogenic compounds." Blumer also cautions that low-level pollution may damage the marine environment by masking natural chemical sex attractants, interfering with chemical food sensing and enemy repulsion. He stated, "There is good reason to believe that pollution interferes with these processes in two ways: by blocking the taste receptors and by mimicking for natural stimuli;..."

A somewhat less pessimistic view is taken by St. Amant (1972). In offshore areas, where chronic spills could result from leaking vessels and plumbing, and discharge of oil-contaminated, produced brine waters, St. Amant viewed the problem as follows:

> Chronic pollution from offshore production sites represents an unknown factor. Daily drips and loss of small amounts of oil or other chemicals overboard do not appear to generate ecological problems because of the relative immensity of the water column. Whether such sublethal pollution will eventually accumulate and cause environmental degradation is yet to be determined. Because of this unknown factor, significant effort should be made to prevent low-level pollution.

Microbial decomposition is one method by which oil is altered or removed from the marine environment. However, according to Blumer (1971), microbial decomposition of crude oil hydrocarbons in the marine environment may not be as encompassing as suggested by some authors. Oil is readily adsorbed by clay and silt and, although adsorption of oil by solids renders the oil more susceptible to microbial oxidation in the water column, almost no bacterial decomposition occurs after burial in the bottom sediments, because of anaerobic conditions in the sediments.

Further, no single microbial species will degrade any whole crude oil; bacteria are highly selective and complete degradation requires many different bacterial species. Bacterial oxidation of hydrocarbons produces many intermediates which may be more toxic than the hydrocarbons; therefore, organisms are also required that will further attack the hydrocarbon decomposition products.

Hydrocarbons and other compounds in crude oil may be bacteriostatic or bacteriocidal; this may reduce the rate of degradation, where it is most urgently needed. The fraction of crude oil that is most readily attacked by bacteria is the least toxic one, the normal paraffins; the toxic aromatic hydrocarbons, especially the carcinogenic polynuclear aromatics, are not rapidly attacked.

The regular discharge of formation waters, "oil field brines", could have a local impact on the plankton. Although formation water is put through a polishing facility and has all but traces of entrained oil removed, it may contain a heavy concentration of dissolved salts and water soluble hydrocarbons. The formation water is usually devoid of dissolved oxygen. Table III- 5 of Section III.A. gives a range of 21.7 ppt to 40.4 ppt for the salts in formation water produced in offshore Southern California.

Some of the discharged formation water would result in a plume trailing away from the point of discharge in the direction of the current, with a core perhaps a few feet in diameter and tens of feet in length. This plume would probably be harmful or lethal to the plankton. Physiological stress would probably result from an osmotic imbalance (cells losing water to sourrounding brine) and low dissolved oxygen. Beyond this zone of stress, however, Mackin (1971) has actually noted a zone of stimulation or fertilization to the benthos and demersal nekton during a study of brine discharge in Galveston Bay. No such zone was found in the planktonic community. Some of the denser, more saline formation water would sink to the bottom even with dilution processes forming an anoxic, high saline layer with entrained hydrocarbons around the points of discharge. See Section III.C.3. for a discussion of the possible impacts of this layer on the benthos.

Red tide outbreaks have occurred in several areas along the Southern California Borderland. Ingle and Martin (1971) have correlated red tide occurrences in Florida with iron compounds of various types and concentrations. Formation waters contain iron in concentrations of about 1 to 2 mg/l (USGS, 1974), but the amount of iron postulated by Ingle and Martin as necessary to trigger a red tide could not be supplied by oil field brines.

Iron compounds have not been mentioned as contributing to red tide outbreaks in Southern California (Riznyk, 1974), but they cannot be ruled out because of the incidents in Florida. Red tides appear to occur when ocean nutrients are extremely low and often follow a diatom bloom. The possibility of red tides exists in California waters, but we do not have evidence to indicate that an occurrence will be caused as a result of this proposed sale and subsequent operations. Further, we have no evidence to indicate that other constituents of brines could be responsible, since they are not now known to be limiting factors in red tide blooms.

The remaining impacts suffered by the plankton will be localized, and are primarily related to increased turbidity. These impacts are brought on by the discharge of drilling fluids and drill cuttings, and the jetting of sediments during underwater pipeline burial. The turbidity conditions resulting from these operations are seen on the surface as a visible plume in the direction of local currents and usually disappears within a few yards to a mile from the source. The effect of this turbidity on a given parcel of water is of short duration, lasting on the order of a few hours at the most. The physiological effect is to depress photosynthesis by obstructing the penetration of sunlight. Turbidity increases may have a smothering effect on zooplankton, particularly oceanic varieties which are less accustomed to such insult than neritic varieties. The increased turbidity could result in the clogging of the filter feeding mechanisms of the zooplankton, resulting in decreased filtering and feeding efficiency. Another possible effect from increased turbidity is toxicity to organisms due to suspension of heavy metals and pesticides located in the sediments. Temporary food chain uptake could also occur due to this.

Detrimental effects will be increased locally if exploratory or platform drilling occurs near the Hyperion or Orange County sewage outfalls, located in federal waters (SCCWRP, 1973). Pipeline construction will cause similar effects if the corridors traverse near the sewage outfalls in state waters (Graphic 2). The resuspension of these sediments and included pollutants will cause localized plankton mortalities and possible incorporation of certain non-biodegradable substances (especially DDT near the Hyperion outfall) into the food chain.

Of particular interest are the planktonic larvae of various pelagic and benthic organisms. These meroplankters (planktonic for part of their life cycle) are generally considered to be most sensitive to environmental stress and predation while in the water column. They are especially vulnerable to oil spills since they are generally concentrated near the surface of the ocean. In fact the neuston, or the community of organisms in the uppermost 5 centimeters of the ocean surface, contains many aggregations of planktonic larvae. Mass kills of planktonic larvae could be expected with large oil spills in the range of 30,000-100,000 bbl. This might damage the year class strength of certain species of fish and could affect the distribution of benthic invertebrates in a given area for a short period of time. However, based on the high reproductive potential and numbers of larvae released by these animals, distributional and survival powers should not be significantly affected although there might be a locally adverse effect.

In summary, our conclusions concerning the impacts of this proposal on the plankton are as follows:

1) Oil spills - a major oil spill will ultimately occur and many minor spills will occur. The plankton populations of the Southern California ecosystem will probably be able to absorb the impact of a major oil spill in the open sea and recover fairly rapidly. However, studies to date are so few that the magnitude of the impact is still unknown. The greatest number of planktonic organisms directly killed from a major spill would be found in the neuston or the community in the upper 5 cm. of the ocean surface. Since annual productivity is greatest in spring and summer, especially along the coast in upwelling areas, a spill in this part of the year would do the most damage to plankton productivity and standing stock. See Table III-20 for further details.

2) Chronic low-level discharge - sublethal, carcinogenic, and food chain uptake impacts are largely unknown but have the possibility of being the most severe effects of oil production in the marine environment. The literature surveyed and the studies conducted so far indicate that this impact is still in the unknown category, but potentially dangerous.

3) Discharge of formation waters - probably harmful or lethal to the plankton in local areas around the platforms. Effects include physiologi-

cal stress from low dissolved oxygen and high concentrations of dissolved salts. An unknown effect could be uptake of water soluble aromatics not removed in the separation process. Discharged formation water is a potential large source of chronic, low-level hydrocarbon pollution. See Table III-20 for estimates of amounts of formation waters discharged.

4) Turbidity effects from pipeline burial and discharge of drilling muds and drill cuttings - local effects of low severity that would be concentrated around pipeline corridors and platforms. These effects would be immeasurably small at more than a few feet from the point of discharge. More severe effects could include resuspension of toxic or harmful pollutants in the sediments by activity around sewage outfalls. These could cause plankton kills and possible uptake of non-biodegradable substances into the food chain (e.g. DDT). See Table III-20 for further details.

Table III- 20 was compiled from estimates made in Section III.A. of this statement and the scenario presented in Section III.B. for oil spills. The major spill is as described in case 2 of the scenario. It must be emphasized that these are rough estimates of probable events and effects. For comparative purposes; the contribution from natural oil seeps in the Southern California Borderland is estimated to be 100 bbl/day (Mikolaj, Allen and Schleuter, 1972) or on the order of 36,500 bbl/year.

Table III-20 A Summary of Possible Impacts on the Plankton for a Range of Proposed Activity in the Southern California Borderland

Activity	Maximum Amounts	Open Ocean Area Impacted	Duration	Estimated Occurrence	Impact	Plankton Impacted	Relative Severity
1. Oil Spills							
Major Spill	30,000 - 100,000 bbl	200-500 square miles	60 days	1/7-10 yrs.[5]	Direct kill	Phytoplankton and Zooplankton	low
						Neuston[1]	moderate-high
					Decrease in productivity	Phytoplankton	low for total populations; up to 50% decrease for some species
					Sublethal effects[2]	Phytoplankton and Zooplankton	potentially high
Small Spill	500 bbl	2-15 square miles	1-10 days	Unknown	Direct kill	Phytoplankton and Zooplankton	low

Table III-20 (Cont.)

Activity	Maximum Amounts	Open Ocean area Impacted	Duration	Estimated Occurrence	Impact	Plankton Impacted	Relative Severity
Chronic Low-level Discharge and Minor Spills (<50bbl)[3]	4,758-41,010 bbl	Southern California Borderland	Production Life: 20-60 yrs.	Throughout production phase		Neuston	moderate-high
					Sublethal effects	Phytoplankton and Zooplankton	potentially high
					Sublethal effects	Phytoplankton and Zooplankton	potentially high
					Uptake of Petroleum Hydrocarbons in Food Chain	Zooplankton	unknown
2. Discharge of Formation waters	1.5-14.0 billion bbl.[4]	Local-around platforms	3rd year-life (20-60 yrs)	Throughout production phase	Loss of fluids to brines	Phytoplankton	low
					Decreased respiration due to low oxygen content	Zooplankton	low
					Uptake of water soluble aromatics	Zooplankton	unknown

Table III-20 (Cont.)

Activity	Maximum Amounts	Open Ocean area Impacted	Duration	Estimated Occurrence	Impact	Plankton Impacted	Relative Severity
3. Drilling muds and Cuttings Discharge	Mud Chemicals Discharge 14.0-84.0 thousand tons Drill cuttings 0.5-3.0 million tons	Local-around platforms	Drilling phase-3-7 yrs.	Continuous during drilling	Decreased productivity due to increased turbidity	Phytoplankton	low
					Clogging of filter-feeding mechanisms	Zooplankton	low
					Toxicity of chromium	Phytoplankton and Zooplankton	unknown
4. Pipeline Burial	4,000-8,000 cubic yards of sediment per mile	Local-around pipeline	3-5 yrs.	During pipeline burial (<250 ft.)	Decreased productivity due to increased turbidity	Phytoplankton	low
					Clogging of filter-feeding mechanisms	Zooplankton	low
					Resuspension of harmful pollutants	Zooplankton	potentially high

Table III-20 (Cont.)

[1]Neuston - plankton community in upper 5 cm. of water column.

[2]Sublethal effects - adverse effects on physiology of growth and reproduction and on instinctive and voluntary behavior. Includes possible carcinogenic effects.

[3]Chronic low-level discharge and Minor spills - includes pipeline leaks, equipment failure and human errors, weather damage, platform fires and explosions, minor spills, ship-platform collisions. Amount taken from Table III-11 in Section III.A.

[4]Amount calculated using estimate of 50% water cut of oil and water produced and a range of 1.6-14.0 billion bbl. of oil produced over the life of the proposed area. The range could vary from a 20-30% cut of formation water during the first half of a well's producing life to 2 to 3 bbl. of formation water/bbl. of oil produced during the last half of a well's life.

[5]Recurrence interval estimated for large spills greater than 90,000 bbl. For a range of anticipated production of 1.6 to 14.0 billion bbl. of oil for the proposed lease sale.

Production	Spills	Recurrence Interval
Lows	1.6	37.5 years
Mean	7.6	7.9 years
High	13.7	4.4 years

b. Impact on the Nekton

Nekton, by definition, include all marine animals which are active swimmers and are able to migrate freely over considerable distances both horizontally and vertically. This motility combined with irritation sensing ability and natural escape and avoidance behavior, enable them to avoid localized adverse conditions to a great extent. Therefore, the most significant direct impact on the nekton would be from a massive oil spill that would be unavoidable over a large area. Impacts from chronic low-level discharge of oil into the marine environment as well as sublethal effects are the most difficult to assess but may be the most severe. This section will consider impacts on fish and nektonic invertebrates. For a description of this section see Section II.E.4. For impacts on the mammal members of the nekton, see Section III.C.3.

Little information has been found on the effect of spilled oil on members of the nekton other than fish. Hufford (1971) cited several early studies which show that crude and bunker oils harmed or killed fish eggs in laboratory experiments. Mironov (1969) reported concentrations of crude oil at 0.001 $ml/_1$ (1 ppm) were toxic to eggs of anchovy, scorpionfish and sea parrots of the Black Sea. He also cited Mironov (1970) who found that oil affects fish respiration by clogging gills and damaging gill tissue. Blanton and Robinson (1973) support this finding. They found gill damage to specimens of seven different species of fish exposed to a Louisiana oil spill.

Morrow (1974) reported significant mortalities to young coho and sockeye salmon when crude oil poured on the water surface reached 500 ppm or greater. When fish were force-fed oil at 1 g per 100 g of body weight, dipped into an oil film, or had a drop of oil placed on each gill, they showed no significant mortalities. Morrow suggested the toxicity of unsaturated aromatic compounds probably results from alteration of cell membrane permeability, especially in the gills, by dissolution of fatty substances from them. This, in turn, destroys the ability to regulate salt balance. This results in a rapid increase of monovalent ions in the blood and probably also interferes with CO_2-HCO_3^- regulation.

The effects of direct kill and gill damage would be restricted to the epipelagic (ocean zone from 0-150m) fish, neritic (nearshore) fish, and nektonic invertebrates in the upper layers of the ocean in the event of a massive spill such as described in Section III.B. of this statement. Case I would affect the neritic fish the most, Case II the epipelagic, and Case III the demersal (or bottom) fish. In all cases of a major spill, the fish larvae and fry in the upper layers would be most severely affected.

For example, Ahlstrom (1959) states that fish larvae in the Southern California Borderland area are concentrated in the upper mixed layer of the ocean and the upper part of the thermocline between the surface and 125 m. The Northern anchovy and Pacific hake larvae were the most abundant in this layer from the CalCOFI surveys from 1955-1958 (Ahlstrom, 1965). Not only would these larvae be exposed to direct kill from water soluble fractions of petroleum hydrocarbons but also they would be most vulnerable to death from starvation in the event of a massive spill that killed off their food supply of phytoplankton and zooplankton. According to Hunter (1972), anchovy larvae just after yolk adsorption require up to 37 times the food density as older larvae. If this food were not available over a large scale, the year class strength of the anchovy or another species might be damaged. The maximum damage from this impact would occur in the winter and early spring when peak fish reproduction takes place.

On the other hand, if the zooplankton become contaminated with oil or petroleum hydrocarbons, the larvae or fish feeding on the zooplankton could suffer stress or take up the hydrocarbons into their tissues. Copepods in the zooplankton, mentioned in Section III.C.1.a. as injesting oil without apparent harm, are an important food source for the epipelagic Northern anchovy (Horn, 1974). The Northern anchovy occupies a central and significant position in the trophic structure of Southern California waters. It is one of the most abundant species in the region according to Smith (1972) and is a source of food for large game fish in the area such as bonito, albacore and bluefin tuna. Therefore, the petroleum hydrocarbons have the potential of reaching up to the top layers of the food chain. Blumer (1973) as stated by R. C. Clark (1973) said the hydrocarbons contained in the zooplankton upon which the basking shark fed had passed through the digestive tract without fractionation or structural modification. These hydrocarbons were deposited in the shark's liver.

Evidence is increasing which suggests that marine organisms have the ability to depurate accumulated petroleum hydrocarbons (See Sections III.D.1. and III.E.3.). This suggests that the classical food chain buildup does not occur with petroleum hydrocarbons. The fact that the animals tested do accumulate hydrocarbons in rather large quantities indicates that temporary food chain buildup can occur. The naphthalenes remain within the prey species the longest and are also among the most toxic petroleum fractions (Anderson et al, 1974). The carcinogen benzo-a-pyrene acts similarly to naphthalenes in animal tissues. If the temporary accumulation of naphthalenes and/or benzo-a-pyrene reached high enough concentrations in predators, death or possibly cancer could result. The impacts would be of far shorter duration and have a lesser total impact on the marine ecosystem than if the clasical food chain buildup did occur.

Nektonic invertebrates such as the extremely abundant pelagic red crab (see Section II.E.4.e.) could be damaged by oil clogging their filter feeding mechanisms. The red crabs feed on phytoplankton and are in turn fed upon by sea birds, whales, oceanic game fish, kelp-bed game fish, yellowfin tuna, albacore and skipjack (Horn, 1974). Although the maximum concentrations of these crabs are in the coastal upwelling areas and in the California Current off Baja California, climatic and mass transport variations sometimes bring large numbers into the lease area.

After the Santa Barbara oil blowout in 1969, the California Department of Fish and Game (1969) found no damage to the nekton resulting from oil contamination. They looked at fish abundance by trawling samples and sonar transects. Examination of the Santa Barbara Underwater Gardens Aquarium also revealed no adverse effects. However, since fish abundance varies greatly in space and time and sampling methods are generally crude, it is difficult to definitely conclude that oil pollution does not affect fish abundance. From diver observations, the Department reported that fish reacted to the surface oil as if it were a floating kelp bed. Ebeling et al. (1971) observed no effects on the nekton except for the temporary disappearance of mysid shrimp from kelp canopies.

A more common approach to studying the effects of oil on fish is to expose them to various amount of oil in a laboratory aquarium (e.g., Spears, 1970). This may not necessarily be of great value in assessing the impact of spilled oil in the ocean because of the vast difference between an aquarium and the ocean and the fact that oil concentrations in the water during a spill are rarely known. Rice (1973) has noted that in laboratory studies, pink salmon fry are able to detect low sublethal concentrations (as low as 1.6 mg/1 of oil for older fry) of Prudhoe Bay crude and show avoidance behavior to it. Nelson-Smith (1971) has also stated that fish seem to avoid contaminated areas. While this has survival value for the fish, the contaminated areas then constitute an unuseable habitat.

In addition to avoiding contaminated areas, nektonic organisms might have another defense against accumulation of petroleum hydrocarbons. Tests on some species of fish, shrimp and oysters in the Gulf area demonstrate that these organisms do accumulate petroleum hydrocarbons in thin tissues fairly rapidly to concentrations an order of magnitude higher than exposure concentrations. The low-boiling napthalenes are concentrated to the greatest extent. However, these organisms also have the capacity to depurate (purify or cleanse) the hydrocarbons after exposure to oil-free sea water with varying rapidity. Shrimp and fish took from 6 to 14 days to return to undetectable levels, oysters and clams 10-52 days (Anderson and Neff, 1974). It is clear that these findings should be investigated further and the exposure concentrations and background levels related to possible concentration ranges of hydrocarbons in the ocean.

The sublethal effects from oil pollution, especially from the chronic low-level discharge of oil into the marine environment, are the least known and potentially the most dangerous to the nekton. Feeding, reproduction, and social behavior in fish and lobsters have been disrupted by soluble aromatic derivatives as low as 10-100 parts per billion (Todd, et al., 1972; Hasler, 1970). Interference with predator detection of prey is also possible. Whittle and Blumer (1970) report that predators are attracted to prey at the part per billion level. This low-level interference could also disrupt migratory and homing detection (Nelson-Smith, 1973).

Blumer (1969) has proposed that physiological/behavioral effects may interfere with fish nutrition by:

a) blocking taste receptors, and

b) mimicking natural chemical messengers which attract predators to their prey.

Boesch (1973) cited the unpublished work of Todd and Atena (Woods Hole Oceanographic Institution, Chemotaxis Group). They worked with behavior patterns of yellow bullheads, *Ictalurus natalis*, and found that the fishes' complex, chemically-mediated social behavior developed high intensity conflict behavior when exposed to water soluble fractions of Kuwait crude oil. The Santa Barbara crude from this area has a lower water solubility and lower fraction of low-boiling toxic aromatics than Kuwait crude. These sublethal effects could possibly affect the full range of nekton in the Southern California Borderland Area: the epipelagic fish, neritic fish, demersal fish, deep water fish, fish larvae and nektonic invertebrates.

So far as we have been able to determine, there is no information on the impact of oil on the deep water fauna. Conceivably these organisms may tend to be more stenotopic than shallow water forms and, therefore, possibly more subject to harm from oil pollution. On the other hand, the deeper water will afford a greater chance of dilution for the oil. Petroleum hydrocarbons are accumulated in marine organisms and although they tend to eventually be depurated, predation of surface organisms or other animals which have accumulated oil could serve as a source for large accumulation of oil into certain of these potentially sensitive deep sea forms.

Other activities that could have an impact on the nekton are the discharge of formation waters, drilling muds and cuttings discharge and the disturbances due to pipeline burial and platform construction. While the nekton would not be affected significantly by the heavy brine content of the formation waters and their low oxygen content since they would be able to avoid the local areas of discharge, a more severe effect might be the uptake of water soluble aromatics in the discharged formation waters. These water soluble aromatics are not removed in the separation process. Also, the amount of oil discharged into the environment is considerable when examined over the long range. Using a range of 750,000-1,000,000 bbl oil produced per day at peak production for the proposed lease area and an average of 1 bbl of formation water produced per bbl of oil produced, 0.75-1 million bbl of formation water per day could be discharged. Considering a maximum amount of 50 ppm of oil allowed by OCS regulations in this formation water, a maximum of 37.5-50 bbl oil/day could be released into the Bight area from this source.

Therefore, the formation water would be another source for chronic low-level discharge of oil.

Drilling muds and cuttings discharge could clog the filter-feeding mechanisms of the anchovy, pelagic red crab and some of the other nektonic invertebrates, but this would be of minor significance and concentrated locally around the area of discharge. The chromium content of these discharges could be a toxic pollutant that has the potential of affecting all of the nekton. However, the severity of this effect is unknown.

The impact of pipeline burial and platform facilities construction would be localized and might disturb the habitat and food sources of some demersal fish, especially those on the Santa-Rosa Cortes Ridge and in the nearshore areas. The demersal fish feed largely on benthic organisms and the greatest threat to their food source would be burial and construction activity in the areas of sewage outfalls and heavy bottom sediment pollution which would be resuspended into the water column. These harmful substances (e.g. DDT) could be taken up into the benthic community which would therby serve as a link for passing the pollutants on to bottom-feeding fish. (See Table E4-1 of Appendix 10.E.4.).

A final observation on the fragility of the outer areas in this proposed lease sale would apply not only to the nekton but also to other parts of the marine environment in these areas. When discussing the Santa Barbara Oil Blowout, Straughan (1971) mentions that the marine environment was already subject to some stress from natural oil seeps, low salinities due to high runoff and a possible increase in the pesticide levels from orchards. Therefore, these natural and man-induced factors might have mitigated the stress to the marine community imposed by additional oil pollution. However, this hypothesis cannot be applied as strongly to the outer pelagic and benthic environment of the Southern California Borderland, since for the most part the uniqueness of this area is due to the fact that it is a relatively undisturbed environment. Therefore, the additional stresses applied from increased human activity, construction, production and development, and accidents in the outer region of the proposed lease area (e.g. the Santa-Rosa Cortes Ridge) will be applied to communities that have not been subject to the long-term stresses associated with the inshore waters and high levels of human activity. This might well result in more severe effects to these outer areas because of their low tolerance to non-natural fluctuations in the marine environment.

In summary the possible impacts from this proposed sale are as follows:

1) Oil spills - A major oil spill will ultimately occur and many minor spills will occur. The most significant effects of a massive spill would be some direct kill of the nekton in the upper layers of the ocean. A massive kill of plankton from a large spill could remove the food source of epipelagic fish and nektonic invertebrates resulting in a decrease in the year class strength of some species. The nekton should be able to recover from this effect fairly rapidly due to the

large reproductive capacity of most of the species. Sublethal effects are unknown but could be the most severe. See Table III-21 for further details.

2) Chronic low-level discharge - sublethal (i.e. masking or interfering with prey detection, reproductive patterns, social behavior, migration and homing behavior), carcinogenic and food chain impacts are largely unknown but have the possibility of being the most severe effects of oil production in the marine environment. The literature surveyed and the studies conducted so far indicate that the severity of these impacts is still in the unknown category, but potentially dangerous.

3) Discharge of formation waters - localized effects that would be avoided by the nekton for the most part. Discharged formation water is a potential large source of chronic, low level hydrocarbon pollution. The effect of water soluble aromatics not removed in the separation process might be most severe for epipelagic and neritic (nearshore) species. See Table III-21 for details.

4) Discharge of drilling muds and cuttings and the effects from pipeline burial and platform construction - local effects of low severity that could result in the clogging the filter-feeding mechanisms of the Northern anchovy and pelagic red crab, for example, and disturb the habitat and food source for some species of ddemersal fish. These areas would probably be avoided by the nekton for their duration. More severe effects could be the toxicity of chromium in drilling muds to all the nekton and the resuspension of harmful pollutants in the sediments around sewage outfalls to the food sources of the bottom-feeding fish. See Table III-21 for further details.

Table III-21 was compiled from estimates made in Section III.A. of this statement and the scenario presented in Section III.B. for oil spills. It must be emphasized that these are rough estimates of probable events and effects. For comparative purposes, the contribution from natural oil seeps in the Southern California Borderland is estimated to be 100 bbl/day (Mikolaj, Allen and Schleuter, 1972) or on the order of 36,500 bbl/year.

Table III-21 A Summary of Possible Impacts on the Nekton for a Range of Activity in the Southern California Borderland

Activity	Maximum Amounts	Open Ocean Area Impacted	Duration	Estimated Occurrence	Impact	Nekton Impacted	Relative Severity
1. Oil Spills							
Major Spill	30,000 - 100,000 bbl.	200-500 square miles	60 days	1/7-10 yrs.[9]	Direct kill	Epipelagic fish[1], fish larvae, nektonic invertebrates[2]	low-moderate
					Decrease in year class strength due to non-availability of plankton food	Epipelagic fish, fish larvae, nektonic invertebrates	low
					Uptake of PHCs[3] into food chain	Epipelagic fish, fish larvae, nektonic invertebrates	unknown
					Other sublethal[4] effects	All nekton[5]	potentially high

Table III-21 (Cont.)

Activity	Maximum Amounts	Open Ocean Area Impacted	Duration	Frequency Occurrence	Impact	Nekton Impacted	Relative Severity
Small Spill	500 bbl	2-15 square miles	1-10 days	Unknown	Direct kill	Epipelagic fish, fish larvae, nektonic invertebrates	low
					Sublethal effects	All nekton	potentially high
Chronic Low-level Discharge and Minor Spills (<50 bbl)[6]	4,758-41,010 bbl.	So. Calif. Borderland	Production Life: 20-60 yrs.	Throughout production phase	Uptake of PHCs into food chain	All nekton	unknown
					Other sublethal effects	All nekton	potentially high
2. Discharge of Formation Waters	1.5-14.0 billion bbl[7]	Local-around platforms	3rd year-life (20-60 yrs.)	Throughout production phase	Uptake of water soluble aromatics	Epipelagic fish, near-shore fish	unknown

Table III-21 (Cont.)

Activity	Maximum Amounts	Open Ocean Area Impacted	Duration	Frequency Occurrence	Impact	Nekton Impacted	Relative Severity
3. Drilling Muds and Cutting Discharge	Mud Chemicals Discharge 14.0-84.0 thousand tons Drill Cuttings 0.5-3.0 million tons	Local-around platforms	Drilling phase-3-7 yrs.	Continuous during drilling	Clogging of filter-feeding mechanisms	Northern anchovy, nektonic invertebrates	low
					Toxicity of chromium	All nekton	unknown
4. Pipeline Burial and Platform Construction	4,000-8,000 cubic yards of sediment disturbed per mile	Local-around platforms	3-5 yrs.	During pipeline burial (<250 ft.)	Disturbing habitat and food source	Demersal fish[8]	low
					Resuspension of harmful pollutants	Demersal fish	potentially high

[1] Epipelagic Fish - fish living between depths of surface and 125 m. Examples: Northern anchovy, jack mackerel, Pacific mackerel, Pacific bonito, yellowtail.

[2] Nektonic Invertebrates - pelagic red crab, ocean shrimp, bay shrimp, spot prawn, market squid

[3] PHCs - petroleum hydrocarbons

[4] Sublethal Effects - adverse effects on physiology of growth and reproduction and on instinctive and voluntary behavior. Examples: masking or interfering with prey detection, reproductive behavior, social behavior, migration and homing behavior, carcinogenic effects.

Table III-21 (Cont.)

[5] All Nekton - epipelagic, deep-sea, nearshore, and bottom-dwelling fish and nektonic invertebrates.

[6] Chronic Low-level Discharge and Minor Spills - includes pipeline leaks, equipment failure and human error, weather damage, platform fires and explosions, minor spills, ship-platform collisions. Amount taken from Table III-11 in Section III.A.

[7] Amount calculated using estimate of 50% water cut of oil and water produced and a range of 1.6-14.0 billion bbl of oil over the life of the proposed area. This range could vary from a 20-30% cut of formation water during the first half of a well's producing life to 2 to 3 bbl. of formation water/bbl. of oil produced during the last half of a well's life.

[8] Demersal Fish - bottom-dwelling fish. Examples: dover sole, English sole, lingcod, Pacific sanddab.

[9] Recurrence interval estimated for large spills greater than 90,000 bbl. for a range of anticipated production of 1.6 to 14.0 billion bbl. of oil for the proposed lease sale.

Production	Spills	Recurrence Interval
Low	1.6	37.5 years
Mean	7.6	7.9 years
High	13.7	4.4 years

2. Impact on Benthic Marine Life

Environmental impacts which may be expected to affect benthic life adversely will result from the discharge of drill cuttings, accidental spillage of oil (and associated use of emulsifiers) and other toxic materials, and the burial of newly constructed pipelines. A description of the marine benthic communities may be found in II.E.3.

Spilled oil which has not evaporated or been cleaned up or stranded on a beach, after being dispersed into the water as droplets, adheres to particulate matter and sinks to the bottom where it comes into contact with the benthos.

Data of Sanders, Grassle, and Hampson (1971) show immediate and nearly complete mortality of many forms of benthic animals following the spill of No. 2 fuel oil near West Falmouth, Massachusetts. The bivalve molluscs (clams, etc.) seemed espicially vulnerable. Chemical analysis of edible shellfish species made following the West Falmouth spill revealed that the fuel oil had been absorbed or ingested and could subsequently be found in oyster bodies and scallop muscles in quantities sufficient to require the closure of shellfish beds to harvesting (Blumer, Souza, and Sass, 1970). As a rule, when levels of oil concentration in the sediment apparently decreased below a certain level with the passing of time, affected areas were recolonized by opportunistic forms, especially the marine polychaetous worm *Capitella capitata*. This generally occurred within three to six months of the initial oiling. With the passage of about 10 to 20 months, the more sensitive molluscs resettled many areas. However, at some harbor stations which apparently received a heavy oiling, some highly sensitive forms such as the ampeliscid amphipods[1] had not returned after 20 months.

According to Fauchald (1971) the standing crop biomass of the echiuroid *Listriolobus pelodes* in the Santa Barbara Channel decreased dramatically over a 10 year period since the Allan Hancock Foundation (1965) study. The standing crop of other organisms was less affected, including that of the brittle star *Amphiodia urtica*, the other dominant of the area (Wintz and Fauchald, 1971). This decrease could not be attributed to the Santa Barbara oil blowout, although it was suggested as a possibility (together with increased sewage pollution, drilling and change in sediment). Because of the long period of time between the studies, Fauchald could not determine the cause of the *Listriolobus* reduction.

When natural seepage increased during the following spring and summer Juge (1971) found no burrowing organisms nor evidence of them in box cores taken from heavily oiled sediment near Platform A. Fauchald reported that a relatively small, but otherwise normal, *L. pelodes* was found sitting in its shallow depression surrounded by an inch thick layer of black mud mixed with crude oil in one of Juge's cores.

The question of the accumulation of petroleum hydrocarbons in the food chain remains an interesting but largely unanswered question.

Blumer et al. (1970) reported that when oysters *Crassostrea*

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[1] A family of crustaceans related to the common beach hopper or beach flea. Farther offshore, resettlement required about six months. (Sanders et al., 1972)

virginica are exposed to oil-water mixtures, they non-selectively accumulate in their tissues a wide variety of petroleum hydrocarbons which are retained indefinitely. This would mean the ingredients for food chain accumulation are present and favor the ability for ample magnification.

More recently, Lee et al. 1972, exposed the mussel *Mytilus edulis* to isotopically labeled petroleum-derived alkanes and aromatic hydrocarbons and showed that the molluscs released more than 90% of the accumulated hydrocarbons within two weeks of return to isotope-free sea water. Anderson et al. (1973) also reported depuration of oil accumulated in oyster and clam *Rangia cuneata* tissues within 28 days to background levels. They concluded that the accumulation and release pattern indicates that under natural conditions, food chain accumulation of petroleum hydrocarbons would not occur. During drilling operations, drill cuttings are separated from the drilling fluid, cleaned of any entrained oil, and discharged into the ocean.

Carlisle et al. (1964) reported a cuttings pile had little or no effect on the fish population by tower Hazel near Santa Barbara. Encrusting organisms were covered by mud during jetting operations conducted to reduce the pile which had become too high for disposal operations. A diver survey during one operation offshore Louisiana revealed that the drill cuttings on a soft bottom could be detected over a circle 100 feet in diameter. In a small area in the center, the deposit appeared to be about four feet thick. The same survey of the cuttings deposit showed that benthic animals either migrated up through the deposit as it accumulated or colonized even as deposition continued, because it appeared to be inhabited by several animals characteristic of "normal" benthic fauna (Henry Hill, Continental Oil Company, Personal Communication). No study on the actual mortality was conducted. The number of wells that contributed to the pile of cuttings noted in this diver survey was not indicated. As noted in Section III.A. a typical 9,000 foot well may generate 540 tons of cuttings, and up to 20-30 wells may be drilled from a single platform. It is our opinion that the 100 ft. diameter pile of cuttings may represent cuttings from one or a few wells. The total amount of cuttings from 20 to 30 wells would probably cover a larger area around the base of a platform. The distribution of these cuttings would depend on currents and on size of the cuttings, which, in turn is largely dependent on the sediments themselves. Drilling would result in turbidity and the possibility of some burial and smothering, especially near bottoms which are firm enough to support an epifaunal community. Occurring in relatively hard sandy bottoms are small to large populations of non-burrowing, attached benthic animals as the sponges, anemones, bryozoans, and other epifauna. The extent and duration of the impact are nearly impossible to predict at this time. If the drill cuttings are similar in consistency and composition, colonization and repopulation could proceed normally. If, on the other hand, the drill cuttings are wholly foreign in consistency and composition, the deposit might remain barren for a long period or be populated by different types and numbers of animals.

The effect of drill cuttings may be further complicated by the periodic discharge of non-oil based drilling muds. In the past these have been assumed to be harmless. However, drilling muds often contain large amounts of barium compounds (Sec. III.A.). The barium in drilling muds represents a serious, but as yet undetermined, threat to aquatic life, because it is known from upland operations that barium compounds have a severe, almost sterilizing effect on plant and animal life of the soil (EPA, 1972).

Investigating on behalf of the Gulf Universities Research Consortium Offshore Ecology Investigations (1974), Dr. James I. Jones has found barium compounds to be above "normal" background levels in sediments of Grand Isle, Louisiana, where drilling has gone on for many years. Nevertheless, they were low enough to present no known biological hazards. As far as we know no study of this kind has been done on the Pacific Coast. Based on the results of Jones' study, it appears that, when considered separately from drilling muds, regular discharge of drill cuttings will not result in a reduction of the benthic communities of the continental shelf.

In water depths of less than 250 feet new pipelines are entrenched by jetting away the sediment beneath the pipe and allowing the pipe to settle into the underlying trench. Subsequent burial is allowed to take place naturally, primarily be reworking of sediments by bottom currents. The jetting process physically disrupts the sediments in its path and also causes resuspension of large quantities of sediment.

Most, if not all, benthic fauna are either destroyed by the jetting or raised into the surrounding water and rendered completely vulnerable to predation. Although recolonization would begin immediately, the native fauna could not be restored until seasonal reproduction cycles had been completed by representative species from adjacent areas, which would provide a supply of larvae to settle and enter the reworked substrate.

Turbidity resulting from resuspended sediment is capable of producing an adverse impact on filter-feeding molluscan and crustacean benthos by clogging the filter-feeding apparatus or blocking respiratory surfaces.

Another possible source of impact during pipeline dredging is the resuspension of toxic heavy metals and persistent pesticides. As indicated in Section II the area near the Hyperion outfall in Santa Monica Bay is particularly rich in pesticides. The possibility exists that these toxic materials could be ingested by lower marine life and could then be magnified through the food chain until they accumulated in serious quantities in top carnivores, including species harvested for human food.

Obviously, we must conclude that the benthic community will be disrupted or destroyed in the path of pipeline dredging operations. Recovery from the impact will be accomplished in two phases. First, recolonization of the affected area will come from emigration by adults and larval settlement originating from adjacent unaffected areas. The width of the area impacted will be of such a limited distance that we do not consider recolonization an important problem. Second, the time required to establish a breeding population will depend upon substrate, mobility of the involved species, and the length of time required to reach sexual maturity. Initial recolonization will begin, by emigration and larval settlement, within weeks or even days after the impact. Repopulation originating from within the affected area by non-motile species will begin within months to at least five years. The latter time period is based on the assumption that there are subtidal species which require as long as stalked barnacles (*Pollicipes polymerus*) to reach sexual maturity (Straughan, 1971). The probability of impact by resuspended toxic heavy metals and persistent pesticides exists, but the scope and duration of the impact are unknown.

Although the principal habitat of kelp is a rocky bottom area they do form dense beds on bottoms without a permanent exposed hard substrate. Jetting for pipelines will destroy kelp associations in a limited area. According to Dames and Moore (1973) young kelp plants attach to temporary structures such as worm tubes in a sandy area until the holdfasts grow enough to gain a more secure attachment. Recruitment of young kelp plants should soon occur, and these plants would require from one to two years or more to reach maturity.

In sediments chemical degradation of oil can occur but is restricted to the surface layer of the bottom penetrated by ultraviolet light. Ahearn (1973) stated that research on microbial utilization of hydrocarbons for treatment of oily pollutants in the environment, though more intensive in recent times, is still in an early stage of development. It is known that microorganisms can degrade much of a crude oil, particularly the less toxic paraffinic compounds. No single species can degrade all the compounds, but many different species together can metabolize a large number of the compounds, if not all. The rate of microbial degradation, which is principally aerobic, decreases with a decrease in temperature. Large quantities of oxygen are needed. It has been estimated, for instance, that complete oxidation of 1 gallon of crude oil would require all of the dissolved oxygen in 320,000 gallons of water. This comparison may be unrealistic because most oil is at the surface of water in contact with air and only the outer surfaces of oil can be attacked at any one time. It is reasonable to assume, however, that an oxygen-deficient environment may well occur under some oil slicks and in oil-contaminated sediments.

Blumer and Sass (1972) noted that "The preservation of hydrocarbons in marine sediments for geologically long time spans is one of the accepted key facts in current thought on petroleum formation." However, in spite of the stability of hydrocarbons in marine sediments, there are characteristic differences between the hydrocarbons in polluted and unpolluted areas. Tissier and Oudin (1973) found that hydrocarbons in polluted sediments differed from those of unpolluted sediments by having lower percentages of heavy components, by not having an odd carbon dominance in the n-alkanes, and by having polycyclic aromatic hydrocarbons with alkyl chains.

Much of the oil from the Santa Barbara blowout is believed to have settled in the Santa Barbara Channel (Battelle Northwest, 1970) where oxygen is already deficient and is probably not present in sufficient quantities for further decomposition.

The West Falmouth spill provided a unique opportunity for a study of the immediate and longterm effects of an oil spill on an area where the previously existing environmental base was well known (Blumer, Sander, Grassle, and Hampson, 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals (Blumer, Sass, Souza, 1970; Sanders, Grassle, and Hampson, 1972). The resulting erosion spread hydrocarbons to new areas, where the process was repeated. Because of the stability and persistence of the hydrocarbons in marine bottom sediments, Blumer, Souza, and Sass (1970) noted that hydrocarbons may be returned to the biosphere by organisms living and feeding in the sediments. This redistribution of hydrocarbons can be the source of a chronic pollution problem near that spill.

Newell (1948) and Valentine (1966) suggested that a significant number of endemic molluscs, some with a distribution restricted to 1° or 4° latitude, occur within the California Bight. This endemism also occurs in other taxonomic groups (Newman, personal communication, 1974). It is easy to speculate the obvious implication of this: severe or chronic alteration of comparable areas of the environment could eliminate endemic species forever. It is doubtful that a single large spill could wipe out many if any subtidal benthic species by itself. The effect of wide-spread chronic oil pollution or a large oil spill in combination with other types of environmental alterations is not known, but could conceivably contribute to the extinction of some of these endemics.

The relatively pristene and relatively unknown benthic community of Tanner and Cortes Banks undoubtedly contains several endemics (either the 1° latitude types or those endemic to the banks) and/or species which have become rare or even extinct from the mainland shelf hard bottom communities. Near Bishop rock on the Cortes Banks the water is shallow and there is a highly productive and probably unique epifaunal association, including a large population of purple coral. From other information and contour maps, it can be speculated that other productive and unusual hard bottom or even soft bottom communities occur on Cortes Banks in particular. Because there is no island buffer to impede the waves, large waves of 10 ft. or greater probably are common. Because of the shallow water areas and large waves, much of the oil from an oil slick suspended over these areas during rough seas would be forced by the surf to the bottom and oil the epifaunal organisms. Sensitive members of this community will be killed; some species even eliminated from the banks. Biological recovery should be accomplished in the same amount of time as on the mainland shelf, except for any endemic which may be eliminated from the banks.

According to Battelle Northwest, (1970) much of the oil from the Santa Barbara blowout settled in the deep Santa Barbara Channel. The basins are settling sinks for sediments and probably oil. This means that a part of the oil from an oil spill will settle in one of the basins. The diversity and standing crop in the basins is far less than that of the shallower shelves (Hartman, 1960). Because of the more sparse distribution and possible greater sensitivity of many of the basin benthos, oil on the bottom here could cause a greater impact on the basin community than a shallower shelf community. Conversely, particularly the inner basins have been receiving oil for hundreds of years from natural oil seeps. Perhaps spills in the inner basins would have less of an impact than on one of the outer basins, not as subject to years of natural oil settlement.

In summary, impacts resulting from : (1) drilling will cause smothering and burial (especially near bottoms firm enough to support an epifaunal community) for a minimum distance of 100 ft. Recovery will usually begin within months but biological recovery will not be complete for the epifauna communities for at least five years. (2) Pipeline burial will result in community disruption and destruction in the path of the 450 to 900 miles of pipeline corridor construction. Destruction will be minor except in depths of less than 250 ft. Even here destruction will probably be limited to a diameter of about 100 ft. along the pipeline path. Recovery should occur in a matter of days or weeks in the more numerous softer bottoms (Graphic 13), where benthic organisms have mobility abilities. For sessile organisms in kelp beds and harder bottoms, recovery will take from one to two years (for kelp) to five years. (3) Resuspension of polluted sediments will result if pipeline laying or drilling operations occur by the outfalls in Santa Monica Bay or Palos Verdes Peninsula (Graphic 2), or, to a lesser extent, much of Santa Monica Bay and nearshore areas off Los Angeles. Direct kill to benthic organisms will be of limited but unqualifiable extent and duration. Pesticides will be accumulated in the food chain as the result of drilling in these areas. This could be detrimental to certain individuals at the top of the food chain, although no widespread population fluctuations will result from these operations. (4) A large oil spill with a maximal amount of sinking oil (case 3 of the large spill scenarios, Section III.B.) would be the most detrimental to subtidal benthos. Since the literature indicates oil spills cause a range from extreme destruction to little or undetermidable amounts, we must conclude that some destruction will occur, particularly on the one to eight miles of bottom, which could be covered as a result of this spill (see Introduction, Section III.B.). Complete destruction of the benthos is not anticipated, but certain extremely sensitive species may be eliminated from the area covered by oil. The impact of spilled oil eventually ending up in the basins is unknown. Natural oil seeps also end up in the basins (California State Lands Commission, 1974) and, although the oils are often of a slightly different composition, spilled oil is not expected to harm the overall community structure although some very sensitive species may be harmed. Certain species of the shallow water benthos of Tanner and Cortes Banks are expected to be sensitive to oil spills and may be eliminated from these shallow water areas. The impact of a small 500 barrel spill will be neglibible. Frequent small spills, however, could cause an impact, particularly to those remaining sensitive species.

3. Impact on Marine Mammals

Development of the Southern California OCS area could possibly affect some 28 species of marine mammals (Section II.E.6., Volume I). The majority of these species are cetaceans which either reside in or migrate through the lease area. Platforms and work boats may be placed within the migration routes of some of these animals. These animals possess adequate mechanisms to detect and avoid these obstacles, and this avoidance could result in alteration of migratory routes. The effects of such changes are unknown, but in the case of the gray whale could be critical since this species apparently needs to stay within sight of land during its migrations. Alteration of their migratory route seaward could result in loss of sight of land possibly resulting in confusion and disorientation so that some individuals might be precluded from breeding. This situation is purely hypothetical but should be considered before placement of platforms is finalized. A description of marine mammals of this area may be found in Section II.E.6.

Brownell (1971) and LeBoeuf (1971) investigated the effect on marine mammals of the Santa Barbara oil spill. Numerous dead animals found after the spill, including gray, sperm, and pilot whales, dolphins, and elephant seal pups, were examined histologically and chemically for the presence of oil or pathological effects related to oil. No such oil or pathology was found and the deaths were attributed to natural causes. It was also noted that the number of deaths was not abnormally high. However, Connell (1973) analyzed the data of Brownell and LeBoeuf (1971) on mortality of sea lion pups and showed that dead pups had more oil on their bodies than one would expect by chance.

A potential danger to cetaceans is absorption or adsorption through or on the mucus membrane lining the blow hole distal (before) to the nasal plug. This area remains open near the water surface and may become oiled. The ultimate outcome of oil exposure could be a thin oil film covering of the lungs and respiratory passages which has the same effect as pneumonia including death. This disease has been found in humans exposed to particulate oil in the air (K. S. Norris, personal communication, 1974). The highly mobile and intelligent whales and dolphins could avoid contaminated areas, but gray whales migrated through the Santa Barbara oil despite attempts by man to reroute them outside the Channel Islands (ibid). This may indicate there is no danger to whales migrating through oil. However, it is not known if or how many whales were killed, and sank to the bottom on the continental shelf. The existance and extent of this danger, therefore, remains unanswered.

Little is known of the long-term effect of increasing petroleum pollution of the marine environment on marine mammals and no extensive experimental studies of the effects of various petroleum products on different marine mammals have been conducted. The available information based on observation of mammals that accidentally contacted petroleum in the marine environment is summarized here.

The sea otter (*Enhydra lutris*) is unique among marine mammals and is similar to birds in that it has no insulating blubber layer. It is also similar to birds in that the otter is protected from environmental temperatures by an air blanket trapped among the dense fur fibers of its pelt. If the water in which the sea otter lives is polluted by any foreign substance that causes the fur to mat or otherwise lose its water-repellent character so that water reaches the skin, body temperature is lost and the otter soon dies of exposure.

Accidental exposure of two sea otters to a small but unknown amount of oil (probably diesel) in an experimental holding pool on Amchitka Island resulted in fur matting, progressively severe distress, emergence from the water, and death by exposure within several hours (K. W. Kenyon, unpublished data). The oil in this case formed a visible sheen, comparable to that sometimes present in harbor areas where gulls appear unaffected by it. Similar or greater petroleum pollution in the marine environment would prove fatal to any sea otter that came in contact with it.

The northern fur seal (*Callorhinus ursinus*) is insulated from the chilly marine environment by both blubber and fur. Fur seals differ from all other marine mammals except the sea otter because water does not penetrate the dense underfur of its pelt during life. The insulation furnished by the fur is inferred to be necessary to proper thermoregulation in the fur seal and any substance destroying this insulating barrier could result in death by exposure.

Accidental exposure of a less than year-old fur seal on the Oregon coast in 1959 led to the animal being brought to the Depoe Bay Aquarium. It was very thin and weak, and virtually covered with oil. Solvents were used under the direction of a veterinarian to remove the oil and the cleaned seal was washed with soap and water. At first it would not eat, so it was force-fed. The animal recovered completely and was, in 1971, still an exhibit at the aquarium (Personal communication to K. W.

Kenyon from W. Kukaska, 1971). The presence of petroleum did not damage the seal permanently. It may also be inferred that the presence of a large amount of petroleum on the animal interfered in some way with the animal's ability to obtain food and that it would have died from a combination of starvation and exposure if it had not been rescued.

Of the 3,769 seals taken during pelagic sealing studies of the Marine Mammal Biological Laboratory, Seattle during the 1964 to 1971 seasons, one was observed to have "half of the belly matted with grease" (Fiscus and Kajimura, 1967). Among 107 fur seals taken at sea in May 1969, off Washington and British Columbia, 12 (11 percent) were contaminated with oil. Of those, 8 were taken almost directly off the mouth of the Strait of Juan de Fuca. This indicates that fur seals that enter busy shipping lanes may become contaminated by oil (Personal communication to K. W. Kenyon from I. MacAskie, 1971). Among hundreds of thousands of fur seals harvested and observed on the Pribilof Islands breeding grounds, not one seal having oil on its pelage has been recorded. One dead fur seal, less than one year old, found on a Washington beach, was brought to the Marine Mammal Biological Laboratory in about 1948. An area amounting to about 1/5 of its body surface was heavily matted with crude oil. The apparent cause of death was starvation.

Three conclusions are indicated: (1) In most open sea areas where fur seals are found on migration, they infrequently come in contact with petroleum products, although, when they enter busy shipping lanes, oil contamination may occur; (2) The absence of seals contaminated by oil on the breeding grounds suggests that either contaminated animals do not survive to return to the grounds or that none become contaminated during migration, or that they become clean enroute; (3) Information on seal mortality due to any cause is severely limited because fur seals usually occur well offshore, the body is of greater specific gravity then water, and the dead animals sink and thus would rarely be found on beaches.

Two dead harbor seals (*Phoca vitulina*) that were heavily coated all over with crude oil have been reported. One was found in Tacoma Harbor and the other in Tacoma Narrows, Puget Sound, in about 1952. It was presumed that both had died because of the oil on their bodies but no positive determination was made. The source of the oil was ascribed to intentional ship discharges, but no definite linkage was established.

A yearling harbor seal was found completely covered with crude oil in about 1952. When it was brought to the Tacoma Aquarium from a beach in Tacoma Harbor, it was thin and weak. The seal was carefully cleaned, and with care and feeding in the aquarium the seal returned to normal health (Personal communication by C. Brosseau to K. W. Kenyon, 1971).

No harbor seals were observed with oil on their bodies during a 1965 to 1971 study of a colony on Gertrude Island in Puget Sound (Personal communication to K. W. Kenyon from T. C. Newby, 1971).

The conclusions indicated from these harbor seal observations are like those for fur seals: (1) oil covering the body may interfere with normal habits and lead to starvation; (2) petroleum materials do not permanently damage the seal if carefully removed; (3) in an observed colony no seals with oil were found either because of no contact with oil or failure to survive such contact.

LeBoeuf (1971) described the results of a study of the northern Elephant seals (*Mirounga angustirostris*) on San Miguel Island, California, made in March 1969, shortly after the Santa Barbara oil spill. On 25 March 1969, his group tagged 58 weaned pups and five yearlings that had at least 75 percent of their bodies covered with a mixture of oil, mud, and sand. As a control, they also tagged on the same day an equal number of clean pups on an adjacent beach that was free of oil. In a period of one to 15 months after the animals were marked, a total of 25 (40 percent) of the animals that were oiled were sighted in apparent good health and 15 (25 percent) of the control group were reported. LeBoeuf (1971, p. 280) concluded that : "These data support the conclusion that the crude oil which coated many weaned elephant seals at San Miguel in March and April 1969, had no significant immediate nor long-term (1-15 months later) deleterious effects on their health. Had the rookery been contaminated earlier in the season when females were nursing, pups might have ingested the crude oil and more serious consequences might have ensued." Studies of tissues from dead marine mammals found on San Miguel Island after the oil spill failed to show any evidence that they might have died because of oil (Simpson and Gilmartin, 1970).

Orr (1969) conducted field observations and reviewed accumulated data subsequent to the spill. He stated (p.7): "A review of recorded dead gray whales found during migration along the California coast during the past ten years revealed that the incidence of mortality in early 1969 was not unusually high." No mortality among seals, sea lions, or cetaceans was found that appeared abnormal or could be attributed to the oil spill. Orr concluded "...that no positive evidence was obtained to show that any gray whales died on their northward migration from the effects of crude oil pollution."

Orr participated in field studies of wildlife affected by the extensive Golden Gate spill of Bunker "C" oil that occurred on 18 January 1971. Although he reported massive destruction of bird life, he reported no effect on marine mammals (Orr, 1971).

Of the examined California sea lions and other seals that were found dead or dying on Southern California beaches, none have had petroleum products on their bodies (Personal communication to K. W. Kenyon from L. A. Grinar, 1971).

Various observers (Personal communications to K. W. Kenyon) have remarked on the general absence of oil on the bodies of marine mammals found on beaches. The large numbers of dead or dying marine birds observed on the same beaches of California, Oregon, and Washington have been interpreted to indicate that oil has been present in the marine environment at various times over a period of years. Thus, marine mammals would appear to be able to avoid petroleum pollution and are less susceptible to damage from petroleum products than are birds.

Sergeant concluded (1970):

> Sea mammals have a notable ability to avoid oil slicks. However, young harp seals heavily oiled by Bunker "C" oil in the Gulf of St. Lawrence in March 1969, swam 200 miles northward on the normal migration route and there was no evidence of severe deaths. Gray seals avoided Bunker "C" at Chedabucto Bay, Nova Scotia, in February 1970, and deaths attributed to oil were few (B. Beck, Personal communication).
>
> Nevertheless circumstantial evidence accumulates of the cumulative effects of pollutants. Small Cetacea are now rare in the southern North Sea (W. Van Utrecht, Personal communication), where heavy ship traffic, oil and gas exploration and industrial contamination might all be contributory factors to either avoidance or death.

The available information on the direct effects of oil on marine mammals suggests, first, that marine mammals may to some degree avoid areas of oil pollution; and second, that if contamination does occur, the different species respond in different ways. Some could be successfully cleaned.

The direct effect of oil spills, and/or oil pollution during development stages or intentional oil discharge from tanker cleaning operations at sea would very likely kill sea otters.

The effect on other marine mammals cannot be evaluated due to absence of background information. It is possible that animals in affected areas would move elsewhere temporarily or permanently. The direct effect of larger amounts of oil are described above.

Considering the likely occurrence of oil discharged and lost during oil development, colonies and individual marine animals are likely to be affected by the proposed operation. Any sea otter coming in contact with a spill would die, and it is very likely that fur seals would also. Harbor seals and sea lions could very likely die if heavily covered with oil. It is not known if small quantities of oil on the pelage could cause disability or death. It is very likely that large quantities of oil on rookery breeding beaches would be fatal to young animals. It is unlikely that elephant seals would be damaged by oil except during the nursing period when oil could be ingested, with unknown results. There is no information on the effect of petroleum materials on whales and dolphins; there is no record of any cetacean having died directly from the effects of oil in the marine environment.

Even though many variables would have to combine in a critical way before a large amount of oil would directly affect a given population of marine mammals, the position of these mammals in the marine ecosystem means that they would be affected by any amount and type of pollution that affected part of the food chain. These creatures high in the food chain will ultimately suffer if oil pollution continues or increases.

It is likely that an uncontrolled spill of a large amount of oil will occur sometime during oil development. The effects upon a colony or individuals would vary with the species, season of the year, and the amount of oil lost.

There is a definite concern regarding the advisability of conducting oil drilling operations three miles off pinniped rookeries particularly the one on San Miguel Island. Several species of pinnipeds are highly sensitive to human disturbance during the breeding season and may abandon established rookeries for indefinite periods, possibly permanently. No studies have been conducted on the three mile distance question, and evidence from other areas which indicates that pinnipeds occur around oil structures is not fully applicable because there is no involvement of the breeding habitat (see response to Dames & Moore comments, 4.3.2.). Pinniped experts familiar with the California species have been personally consulted including: Dr. George A. Bartholomew, UCLA; Jack G. Carlisle, California Department of Fish and Game; Dr. William C. Cummings, Naval Undersea Center, San Diego; Dr. Murray D. Dailey, Southern California Ocean Studies Consortium; Bob DeLong, U. C. Berkeley; Dr. Burney LeBoeuf, U. C. Santa Cruz; and Dr. Ronald J. Schusterman, Cal State University at Hayward. The thinking of these experts varied from the opinion that there would be no serious problem

(Bartholomew and Carlisle) through the opinion that the rookeries could be seriously disturbed and possibly abandoned (Cummings and Schusterman). The others considered rookery abandonment a viable possibility.

It is interesting that the two who have worked with acoustics, Cummings and Schusterman, were the most pessimistic. If abandonment occurs, it will probably be the result of the high sensitivity of pinnipeds to underwater sound. Schusterman et al. (1972) reported on the high sensitivity of California sea lions to underwater sound. Females are especially sensitive to noises, particularly during breeding season. Schneider (1971) recorded the noise levels from a drilling platform. "The noise levels are extremely high at the low frequency end of the spectrum (f=500 Hz) and for high thruster RPM's, significant noise energy was still contained in frequency components up to 40 KHz." Noises created by drilling are classified information by the Navy, but are of very low frequency and travel distances of over 1,000 miles underwater (Northrop, personal communication, 1975). Sounds of low frequency travel the furthest underwater.

With these facts in mind, it is important to examine the habits of the pinnipeds. Perhaps the most sensitive is the California sea lion (see Section III.D.4.). During the mating and pupping season, the sensitive female feeds almost daily within fairly close proximity to the rookery area. Natural instincts cause her to be far more sensitive during this period. Loud noises from the oil platforms could preclude the females from their normal feeding areas, prevent occupancy of the normal feeding corridors and cause such nervous disruption that they may leave the rookeries as they did on the mainland. According to Le Boeuf (personal comunication, 1975) the area west of San Miguel Island is one of the most productive upwelling areas in Southern California. The whole ocean area around this island is apparently extremely productive. This factor is probably one of the two main reasons that the rookery at San Miguel is the largest in the Southern California area (see Graphic 9). The other reason is that the rookery is protected from much human disturbance. If the rookeries are abandoned the question arises as to where these sensitive marine mammals would or could go. Not to the mainland south of Point Conception, for human disturbance has precluded their presence here for many years. California sea lions begin to be replaced by the Steller sea lion north of Point Conception possibly because of temperature preference or tolerance. Therefore, the California sea lion probably would not be able to increase its population significantly on the mainland north of Point Conception. It is probably significant that there are no significant breeding areas on the Channel Islands other than San Miguel, San Nicolas, and San Clemente Islands (considerably to the north of the bombing target areas on the latter). These islands are all under the jurisdiction of the military and consequently are protected from excessive human disturbance. One can only hypothesize why no large breeding grounds have developed on the other offshore islands. A combination of human disturbance and fewer appropriate beaches, with little relief backed by high cliffs, are probably the main factors. According to data presented by Carlisle (1971), San Nicolas Island may have reached its carrying capacity for sea lions and, for some reason, the sea lion population was decreasing on San Clemente Island. It seems unlikely, therefore, that the other Channel Islands will be able to absorb much, if any, increase in pinniped population from San Miguel Island. The northern fur seal, found only on San Miguel, may not be adaptable enough to move to another island for breeding (see Section III.D.4.).

Further leasing of areas off San Nicolas and San Clemente Islands may cause the total abandonment of all major pinniped rookeries in Southern California.

A case 1 spill would result in considerable fouling of the intertidal area of the islands with relatively toxic oil for a considerable period of time. This could result in the most severe damage to eyes, respiratory tracts and pup-mother recognition of the three spill types.

A case 2 spill could also possibly coat a large number of marine mammals if they happen to surface for air in the spill or come in contact with oil coated beach or rock of the intertidal. However, the effect of this oil coating would be less severe because the more toxic portions would have already evaporated or been otherwise weathered.

A case 3 spill would have little if any affect on marine mammals since it would settle out near the spill site and would not travel any significant distance or come ashore.

In summary, of all the dangers involved in this proposed lease, that to pinnipeds is potentially the worst. Simple platform installation or exploratory drilling off San Miguel Island could cause the elimination of sea lions, fur seals, and harbor seals from their principal breeding area in Southern California. Further leasing off San Nicolas Island and other islands in the future could prolong the elimination of these species from Southern California for many years.

A large oil spill could cause mortalities to fur seals and sea otters and respiratory failure to cetaceans.

D. Impact on the Biological Communities of the Coastal Zone

1. Bays, Estuaries and Marshes

Bays, estuaries and marshes are critically important biologically. Estuaries are not as large or numerous in Southern California as they are in some other portions of the U.S. Much of the estuarine environment has been severely altered or destroyed. Therefore, it is essential to preserve the remaining unaltered areas.

The intertidal organisms reported killed during the Santa Barbara blowout were able to repopulate the impacted intertidal because of large populations at surrounding noneffected areas (Straughan, 1971). More rare species with a very narrow and limited reproductive range could conceivably have become eliminated from the Southern California region. Because of their rareness, a similar situation is possible with certain estuarine species. Several species use bays for nursery areas (California halibut and Pacific staghorn sculpin (see Section II.F.). Other species, both invertebrates and vertebrates, are important permanent residents of bays (Ho, 1974). Allan Hancock Foundation (1965) described an intertidal community in Mission Bay, largely associated with oyster shells, which, as far as we have been able to determine, does not occur on the open coast. Further destruction of estuaries in Southern California will increase the probability that estuarine affiliated species will be entirely eliminated from the coast because of the elimination of nursery grounds and habitat destruction.

The California Coastal Zone Conservation Commission (1975) policy for estuaries and wetlands states: "All remaining coastal estuaries and wetlands and buffer areas necessary to protect wetlands and their wildlife and bird habitat values shall be preserved, enhanced, and where possible, restored." This is evidence that the state of California, while realizing the importance of these areas, is also determined to maintain their ecologically functional importance. A description of California estuaries may be found in Section II.D.1.

Although we believe there are other human influences which are potentially more detrimental to bay and estuarine organisms, oil drilling and oil spill impacts should also be considered both as a potential danger in themselves (see below) and as a complicating factor to other impacts. Foster (1974) did report massive mortalities in the Santa Barbara Harbor during the 1969 blowout. Most of the following concerns the impact on estuaries of the Gulf of Mexico where oil drilling has stimulated thought and some research on oil derived impacts. As indicated in Section III.B., the differences between geographic regions add to the already numerous variables to such an extent that interpolation of the effects from one region to the other becomes highly questionable. Adverse impacts resulting from offshore oil production which are possible in wetlands and estuaries include: pollution by crude oil and subsequent hydrocarbon uptake by organisms, environmental disturbance of habitats during pipeline construction operations, and loss of habitat when land is utilized for onshore pipeline terminals, gas and oil treating facilities.

Largely depending on the quantity of oil spilled, differing impacts may be expected which are directly related to oil concentrations near the spill area. Large spills, such as those resulting from tanker accidents, have demonstrated that definite biological damage can result from exposure of living organisms to high concentrations of petroleum hydrocarbons. For example, when the Tampico-Maru ran aground off the coast of Baja California in 1957, 50,000 to 60,000 barrels of diesel fuel caused widespread mortality among many benthic organisms of the area. These animals included lobsters, abalones, sea urchins, starfish, mussels, clams and smaller forms. Such damage occurred along the shoreline and up to depths of 15 to 25 feet (North, 1973; Ketchum, 1973). Recovery occurred gradually over several years time and began with a profuse bloom of subtidal algae within four months after the wreck (North, 1973). This latter development probably resulted from the absence of grazing animals which had been eliminated by the spill. The animal species were gradually reestablished over seven years but at populations considereably reduced from their former levels. This incident points out the great damage caused by spills of fuel oil that reach confined areas such as bays and estuaries with restricted circulation. The diesel fuel of the Tampico-Maru would be considered more highly toxic than the crude oil produced by offshore drilling operations because it contained a greater concentration of aromatic hydrocarbons. Petroleum which contains a greater amount of aromatics is usually considered more toxic (Clark, 1973). However, both crude oils and their refined products contain compounds that are toxic to species of marine organisms (Ketchum, 1973).

Studies of toxicities of petroleum on marine organisms are few but increasing in number. Mironov (1971) as cited by Ketchum (1973) tested toxicities of crude oil (unspecified type) on eleven phytoplankton species and found that cell division was delayed or inhibited by oil concentrations ranging from .01 to 1000 ppm and that copepods were sensitive to a 1 ppm suspension of fresh or weathered crude oil. In addition to inhibiting the growth of suspended phytoplankton in the water column, similar effects may be expected upon cells of benthic and epiphytic algae along the bottom and edges of estuaries (Stone, 1972).

According to Boesch (1973), several early studies have demonstrated the effect of petroleum hydrocarbons in retarding phytoplanktonic growth although he stated that "...little is known of how oil affects physiological processes of organisms other than vascular plants". According to Boesch:

> Gordon and Proust (1972) studies in situ the effects of some crude and refined oils on marine phytoplankton phytosynthesis. At low concentrations (less than 45 mg/1) bicarbonate uptake 1/ was increased as much as 20% over controls. At concentrations greater than 50 to 100 mg/1 of crude and No. 2 and No. 6 fuel oils, uptake was significantly decreased.

Yet North (1973) stated that our knowledge of the effects of petroleum upon phytoplankton is woefully inadequate. He affirms that while large scale effects on permanently planktonic species may be small, influences on larvae and reproductive cells of benthic species might be significant.

Ketchum (1973) cautioned that while effects of petroleum depend upon proximity to and type of oil released, "Any release of oil into the environment carries a threat of destruction and constitutes a danger to world fisheries." However, other authors believe the adverse effects of petroleum hydrocarbons on the biotic communities of Louisiana, at least, are less significant.

St. Amant (1973), speaking of the oil producing structures in the bays, offshore areas and marshes of his state stated:

> Louisiana's coastal areas with more than 25,000 producing wells, with some fields that have been in production for more than 40 years, and most of which has existed for

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1/ Bicarbonate uptake is a measure of phytosynthetic activity.

> 20 years, serves as a typical area of high production and long-term pollution.

Yet St. Amant, aware of possible environmental damage which may result from "...chronic mismanagement of the environment..." stated:

> Long-term exposure in Louisiana does not seem to have resulted in significant changes in the biotic productivity of the marine system and the presence of normally occurring hydrocarbons at levels of from 100 to 500 ppm in bottom mud tend to confuse attempts to determine accumulative levels of petroleum hydrocarbons in the substrate.

While studies cited previously in this section indicate the retarding effect of petroleum on primary productivity, it is St. Amant's opinion based on his experience that there has been no decrease in overall productivity in Louisiana resulting from introduction of crude oils into the ecosystem (St. Amant, 1973).

Onuf (1973) studied the effects of petroleum in the field near refinery effluents, natural seeps and drilling operations and in the laboratory. He cited a study of Spears (1971) in which the biological effects of oil production upon marine organisms were considered. In the study, Spears compared the yields of harvestable organisms from waters receiving oil field wastes in Texas with nearby waters which were relatively unaffected by human activity and concluded that there was a serious detrimental effect to commercially important organisms due to oil field wastes. However, the high concentration of oil in the creek under study (16 ppm) and the effects of brine effluents made it hard to extend the study to OCS operations. Onuf concludes that "...demonstrable effects of long term pollution by oil are very local and often associated with acutely toxic levels. Where more general effects have been suggested, confounding factors have not been satisfactorily discriminated." According to Onuf:

> The fact that a long period of large scale oil extracting activities has not reduced the productivity of major fisheries along the Gulf Coast of Louisiana suggests that populations in offshore regions can accommodate long term, low level intrusions of oil. The case for estuaries cannot be so succinctly stated nor dismissed. No respectable field experiments (on estuaries) have been reported.

Onuf points out that laboratory experiments have revealed "...dislocations of normal behavior..." by organisms in concentrations of oil found in some estuaries and that adverse synergistic interactions between oil, temperature and salinity stresses warrant direct testing by field experiments. He feels that refinery effluents cause more environmental harm than drilling operations, although he maintains that no predictions are possible on how serious the damage may be.

In the Arrow spill study (Operation Oil, 1970), lobsters appeared to be clean and normal in behavior. Scallops taken near heavily oiled beaches had no oily taste, but chemical analysis of scallops, along with periwinkles, sea urchins, and other bottom dwelling organisms revealed that oil was present in muscle tissue, the digestive tract and other organs.

Galtsoff (1959) noted that the major effects of industrial wastes and the soluble components of crude oil on oysters is a reduction in the rate of various physiological functions, principally ventilation of the gills. Specifically, these pollutants cause a reduction in the amount of time during which an oyster opens its valves for feeding and respiration, and also interferes with the coordination of the ciliary motion with the result that the pumping capacity of the gills is reduced. The reduction in feeding time (simultaneous with respiration) results in a lowered growth rate and poorer quality oyster meats. It is well known that oysters can become contaminated with oil (Erhardt, 1972; Galtsoff, op. cit.; Mackin, 1962) but there is still scientific debate as to whether oysters can cleanse themselves when returned to clean water. See also Section III.E.3. on shellfishes.

Teal and Stegeman (1973) exposed to oil two oyster populations differing in their stored food content and found that petroleum hydrocarbons were accumulated by both groups of oysters. The oysters with a higher stored food content collected the greater amount of hydrocarbons. When these animals were returned to clean water, the hydrocarbon content was rapidly, though incompletely, discharged. These researchers also found that the petroleum contained in the oysters differed from the contaminating oil by showing a greater aromatic content. This result suggested that more aromatic fractions of oil were more likely to be incorporated into the oyster's tissue. The possibility that the oysters were themselves modifying the oil could not be discounted, however.

The accumulation of hydrocarbons in oyster tissue, as was demonstrated by Teal and Stegeman (1973), raises the question of petroleum hydrocarbon incorporation into other members of a food chain which eventually reach higher animals. There is, at present, no evidence that petroleum hydrocarbons are magnified in higher levels of the food chain through consumption of contaminated oysters or fish.

According to Boesch (1973):

> It has been suggested that petroleum hydrocarbons might be taken up by organisms, protected from degradation, accumulated and concentrated along a food chain.

Blumer, Mullin and Guillard (1970) found that a biogenic, natural hydrocarbon produced by certain marine phytoplankters may be accumulated by the copepod, *Rhincalanus nasutus* and the hydrocarbon was also found in oysters, herring and shark's liver. They found that certain hydrocarbons, even highly unsaturated ones, are stable once they are incorporated into a particular marine organism and that they may pass through many members of the marine food web without alteration and may actually be concentrated in tissue. Most hydrocarbons are lipid soluble and thus may accumulate in food webs to the point where toxic levels are reached (Evans and Rice, 1973). Barnacle larvae (*Balanus ballanoides*) maintained in a suspension of crude oil ingested it without apparent harm. Droplets of oil were later passed in the feces (Freegarde et al., 1970) as cited in Ketchum (1973). On the other hand, according to Ketchum (1973):

> Hydrocarbons ingested by marine organisms may pass through the wall of the gut and become part of the lipid pool 1/ (Blumer et al., 1970). When dissolved within the fatty tissue of the organisms, even relatively unstable hydrocarbons are preserved. They are protected from bacterial attack and can be transferred from food organisms to predators and possibly to humans.

Boesch's (1973) conclusion is, that, although "...it appears that petroleum hydrocarbons can be transferred via feeding, at this time there is no convincing evidence for biological magnification as documented for chlorinated hydrocarbons."

Anderson and Neff (1974) reported that the release of accumulated hydrocarbons that they measured in various estuarine animals indicated that, under natural conditions, food chain accumulation would not occur.

1/ Lipid pool - collection in tissue of a group of organic compounds which make up the fats.

Due largely to the work of Anderson and Associates at Texas A&M, evidence is increasing which suggests that marine organisms have the ability to depurate accumulated petroleum hydrocarbons. This suggests that the classical food chain buildup does not occur with petroleum hydrocarbons. The fact that the animals tested did accumulate hydrocarbons in rather large quantities indicates that temporary food chain buildup can occur. The naphthalenes remain within the species tested the longest and are also among the most toxic petroleum fractions (Anderson et al., 1974). The carcinogen benzo-a-pyrene acts similarly to naphthalenes in animal tissues. If the temporary accumulation of naphthalenes and/or benzo-a-pyrene reached high enough concentrations in predators, death or possibly cancer could result. The impacts would be of far shorter duration and have a lesser total impact on the marine ecosystem than if the classical food chain buildup did occur.

The delicately balanced marshland ecosystems would be subject to impacts resulting from sporadic accidental spillages and from chronic oil pollutants and pipeline construction. In the absence of tanker operations, accidental oil discharges would be restricted to oil washed ashore from unforeseen platform accidents or pipeline rupture. Chronic pollutants may result from pipeline leaking and refinery effluents. St. Amant views chronic pollution as posing greater environmental jeopardy than the more obvious damage which results from accidental oil spills. To quote St. Amant (1972) directly:

> Significant ecological or environmental damage must be viewed as a permanent or long term change in the ecosystem that reduces its efficiency and subtracts from its overall productivity. Such a change may be the result of sudden catastrophic events with obvious results; more

> often, it represents the long term cumulative effects of apparently innocuous happenings and of chronic mismanagement of the environment.

While little has been done to methodically answer ecological questions concerning effect of hydrocarbons on highly productive marshland ecosystems, some recent advances have been made. It has been established that large inputs of petroleum into marshlands may result in immediate faunal mortalities and the retarding of floral species.

For example, British studies of salt marsh oiling followed a "moderately severe" spill of crude oil from the tanker Chryssi P. Goulandeis in Milford Haven estuary, Wales (Baker, 1971; Cowell, 1969; Cowell and Baker, 1969). A survey two weeks after the spill showed that oily saltmarsh vegetation had yellowed and was dying although new green growth was showing at the base of some species. Some plant communities remained without new growth a year later. While observations were not made on saltmarsh fauna, mortality was presumed high for aquatic animals in the spill area.

Baker (1971) sprayed saltmarshes in southwest Wales with fresh Kuwait crude oil at different times of the year. Results indicated that a light pollution with crude caused little long term damage to most salt marsh plants, whatever time of the year the pollution occurred, although most damage occurred in warm months. Oiled leaves died but perennial plants recovered well with new growth; annual plants were severely reduced in numbers because they could not recover by new growth before fall. Seed production of annuals was inhibited for one season.

Baker (1971a,b) further stated that heavy pollution is much more damaging because large volumes of oil can soak into the bases of plants and kill their growing points. Penetration of oil into the substratum has direct effects by spreading around root systems and reducing normal bacterial activity or oxygen content. This is indirectly affected by smothering the shoots of plants such as *Spartina* which pass oxygen into the soil via their roots. Baker demonstrated a great reduction in this oxygen diffusion when the leaves were painted with oil and pointed out that the roots of healthy *Spartina* are surrounded by brown, oxidised mud whereas after repeated oiling of the plants, this becomes blackened and anaerobic. Bacterial degradation of oil is largely aerobic and, under such reduced conditions, may be very much slowed down.

Mackin (as cited in Stone, 1972) studied the effects of crude oil on a number of Louisiana marsh grasses. The species included saltgrass, *Distichilus spicata*, cordgrass, *Spartina alterniflora*, and Bates grass *Batis sp.* which are the dominant species in the fresh and brackish marshes. Mackins's data strongly implies that long term exposure to petroleum at relatively high concentrations is quite lethal, and that immediate and rapid cleanup is therefore critical and essential (Stone, 1972).

Boesch (1973) notes that while:

> ...more study and quantification are required, it seems likely that petroleum hydrocarbons, even those not soluble enough to be directly lethal, may inhibit photosynthesis for a short time and under the proper conditions.

The proper conditions refer in part to exposure of plant organisms to petroleum hydrocarbons at concentrations greater than 50 to 100 µg/l

(Gordon and Proust, 1972) as cited by Boesch (1973).

The West Falmouth spill provided a unique opportunity for a study of the immediate and long term effects of an oil spill on an area where the previously existing environmental base was well known (Blumer et al. 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals (Blumer et al. 1970b; Sanders et al. 1972). The resulting erosion spread hydrocarbons to new areas, where the process was repeated. Because of the stability and persistence of the hydrocarbons in marine bottom sediments, Blumer et al. (1970) noted that hydrocarbons may be returned to the biosphere by organisms living and feeding in the sediments. This redistribution of hydrocarbons can be the source of a chronic pollution problem near that spill.

A recent study by Michael et al. (1975) conducted four to five years after the West Falmouth Spill observed that certain species such as oysters, mussels and barnacles were more tolerant than others. The sediment samples of marsh, basin and offshore locations still contained weathered petroleum hydrocarbons. The authors noted that the number of benthic species was lower for the marsh and offshore stations than for control stations unaffected by the spill. This indicates a decrease in species diversity for the affected areas. Michael et al. (1975) concluded that the area was recovering, but the effects of the spill were still evident four to five years after the accident. Although this spill involved fuel oil, the results of the study are informative about the persistence of weathered petroleum hydrocarbons in bottom sediments.

A serious problem for bays, estuaries or marshes is that oil entering and entrapped in these habitats can remain in the bottom sediments, especially in mud or tidal flats, for several years. This results in a periodic release of hydrocarbons to the environment. Such persistence in the bottom sediments has been reported off West Falmouth by Blumer and his co-workers for up to four or five years after an oil spill had occurred. Figure III-18 gives persistence times for oil in a variety of marine environments. It is obvious that oil will remain in mud flats for the longest period. Oil impacting on a narrow intertidal beach with heavy surf will not remain as long as oil entering a wide, shallow mud or sand flat. Here the oil can be trapped in the sediments and not be stirred up by violent wave action. Since degradation of hydrocarbons is mostly an aerobic process, the anaerobic conditions that result as oil works into the sediments and is covered by detritus prolong the breakdown process. Therefore, complete biological recovery in a restricted circulation estuary or lagoon, such as Mugu Lagoon, could take at least four to well over ten years for complete biological recovery from a massive oil spill that entered the area.

In summary, two relatively unaltered estuaries (Mugu Lagoon and Anaheim Bay) and three altered bays, but having endangered bird species nesting areas (Marina Del Rey, San Pedro Bay, and Alamitos Bay) will be in danger of receiving oil from a large spill which, as in Case 1, will move directly on the mainland shore. Because of its wide entrance, there would be a high probability of oil entering Mugu Lagoon should a spill reach shore in this area. An extensive boom of approximately 800 meters and ready for immediate employment would be necessary to prevent this

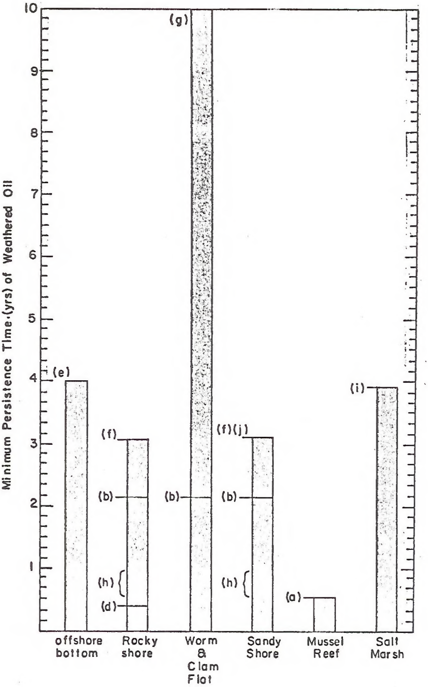

Figure III-18 Observed persistence of petroleum substances in various marine habitats following actual oil spills. Maximum times shown do not necessarily imply complete removal of oil, but may represent author's estimate of persistence or termination of study. See explanatory notes on next page. From: CEQ (1974)

Figure III-18 (continued)

(a) *Mytilus californianus* were described as having an oil coating after six months; non-lethal effect (Chan, 1973).

(b) Analytical determination of oil (Scarratt and Zitko, 1972).

(c) Author is referring to lagoon, which can be broadly interpreted as a salt marsh (Thomas, 1973).

(d) The authors cite visual evidence of oil retained in rocky ledge by false eel grass for several months (Clark and Finley, 1973).

(e) Author's estimate after two years; analytical methods; used #2 fuel (Blumer and Sass, 1972).

(f) Interpretation from statement made by authors; analytical techniques: crude oil (Straughan, 1973).

(g) Visual observation and analytical. JP-5 and #2 fuel (Shenton, 1973).

(h) Visual observation--emulsifiers used on crude (Smith, 1968).

(i) Teal, 1973.

(j) Gas-liquid chromatography analysis (Spooner, 1971).

possibility. If oil from a large spill were to enter an estuary, widespread death and destruction would result. The severity of the destruction would largely depend on the length of time oil remained in the semi-enclosed estuary, with its restricted circulation, before being cleaned up and its persistence in bottom sediments after clean-up. Clean-up operations would of course, cause a certain amount of death. The amount of destruction is unquantifiable, while the time for biological recovery will be from one to several years and up to as many as ten years for mud and tidal flats.

2. Intertidal Areas

The beaches of the Southern California Borderland include both rocky shores and sandy beaches. Sandy beaches predominate the mainland coast while rocky shores predominate the offshore islands.

Beach fauna suffer a harmful impact from offshore oil spills as is evidenced by the results from several previous accidents. Crude oil from the Torrey Canyon spill reached the beaches causing mortalities of intertidal and beach fauna. Detergents used to disperse oil complicated an assessment of damage caused by the oil. However, indications were that mortalities were light on beaches where detergents were not employed (North, 1973).

The spill of #2 fuel oil in West Falmouth, Massachusetts, from the tanker Florida resulted in a high number of mortalities among intertidal and beach (area above high tide) fauna. This spill eventually covered nearly three miles of coastline and resulted in high mortalties (Blumer et al. 1971). Results from studies of this spill demonstrate that immediate catastrophic and later chronic effects can result from a single oil spill (Sanders, 1973). Sanders concluded that species density patterns for polychaetes, gastropods, bivalves, and ampeliscid amphipods, which are residents of the subtidal benthos, follow stress patterns depending on distance from the spill and time of exposure of organisms to the fuel oil.

North et al. (1964) and North (1967) reported the effects to the shallow water and intertidal community caused by the Tampico Maru oil spill in Baja California. The spill involved approximately 19,000 barrels of diesel fuel initially spilled into a cove having restricted circulation.

The following summary was taken from Anderson et al. (1969):

> Immense surf had apparently mixed sand particles with oil films, creating a sludge that rested in depressions and basins on the sea floor. Effects on the fauna were severe. Dead animals were observed wherever natural accumulation of beached debris occurred. Rotting tissue odors were often detectable more than 100 feet from the beach. Species most frequently noted were abalone *(Haliotis cracherodii, H. fulgens,* and *H. rufescens),* lobster *(Panulirus interruptus),* pismo clams *(Tivela stultorum),* mussels *(Mytilus californianus),* urchins *(Strongylocentrotus franciscanus, S. purpuratus),* and sea stars *(Pisaster giganteus, P. ochraceus).* Abundances of these dead organisms left no doubt that a most abnormal condition existed. For example, one heap about 300 feet from the wreck contained 69 abalones (all with decaying bodies still in the shell), 5 lobsters, two fishes, and a variety of mussels, urchins, crabs, sea stars, and smaller invertebrates. Many similar accumulations occurred along the beach as far away as Punta Cabras, more than two miles south of the wreck. Tidepools about five miles south still displayed oil films. Populations of the normally submerged snail, *Tegula funebralis*, had emerged from these pools and were clinging to dry rocks around the edge of each pool. At shallow depths near the wreck, large numbers of dead urchins and mussels had accumulated with sludge in basins. The benthos appeared normal at depths greater than 25 feet.
>
> The marine flora appeared to be damaged only slightly, if at all. Two animal species survived. The periwinkle *(Littorina planaxis),* which occupies a position high in the spray zone, (and thus perhaps suffered only slight exposures to oil) generally occurred in close to normal concentrations. A large anemone *(Anthopleura xanthogrammica)* remained in tidepools. This anemone probably tolerates oily substances because the species was noted in the discharge system of an oil refinery using seawater for industrial purposes.

Chan (1972) studied the impact of the San Francisco oil spill which occurred on January 18, 1971, during the early morning hours when two Standard Oil vessels collided almost directly under the Golden Gate Bridge, releasing 840,000 gallons of Bunker C fuel. This asphalt-like oil was washed up on intertidal shores of the area approximately 30 hours after the spill.

From comparative transect and laboratory observations, it was determined that marine organizms died from being smothered by the oil, with certain species, such as acorn barnacles and limpets, suffering the highest mortality. Comparison of pre-oil and post-oil transect counts showed there was a significant decrease in marine life after the oil spill on the reef. Marine snails suffered less mortality than the sessile barnacles and other sedentary animals. The normally large population of striped shore crabs was missing from the rocky crevices. Finally, marine algal blooms, particularly of *Chaetomorpha aerec* and *Enteromorpha intestinalis,* were also observed in certain reef localities.

On a large mussel *(Mytilus califorianus)* reef there was only about a 2% die off from unknown causes approximately 2 months after the spill. The species believed to have been killed as a result of the spill are shown on Table III- 22.

Table III-22 Intertidal Species Killed as a Result of The San Francisco Bay Oil Spill (From Chan, 1972).

Chthamalus dalli	acorn barnacle
Balanus glandula	" "
Acmaea spp	limpets
Pachygrapsus crassipes	striped shore crab
Littorina planaxis	periwinkle
L. scutulata	"
Pollicipes polymerus	stalked barnacle
Tegula funebralis	(oil may have contributed to a population decrease)
Phyllospadix scouleri	(only slight die off)

The communities of the Tampico and San Francisco Bay oil spills eventually were repopulated indicating that oil spills do not permanently damage impacted intertidal areas.

The damage caused by the Santa Barbara oil blowout was not extensive, but was significant at localized heavily oiled areas to specific organisims, particularly located on the upper intertidal (Foster et al. 1971a). Table III-23 and III-24 list the species killed or believed to be damaged during the blowout.

Table III-23 Species Killed from the Santa Barbara Oil Blowout (From Foster, 1974).

Rocky intertidal Zone

- Barnacles *(Chthamalus)*
- Surf grass *(Phyllospadix* spp.)

- Polychaete worms
- limpets *(Acmaea paleacea)*
- High intertidal crevice fauna (mostly arthropods)
- Mussels (*Mytilus* spp.)

Sandy Beaches

- Sandy beach macrofauna
  Euzonus, Emerita, Orchestoidea

Deep Subtidal Zone

- Benthic Invertebrates

Neritic Habitat

- Marine Birds

Table III-24

List of organisms reported damaged or for which damage was highly probable. Insufficient data to determine total killed or biomass lost. (From Foster, 1974)

Rocky Intertidal Shore	Notes
Kelp crabs (*Pugettia producta*) Hermit crabs (*Pagurus* spp.) Isopods (*Idotea* spp.) Snails (*Lacuna* and *Acteon* (?))	in surf grass
Barnacles (*Pollicipes*) Algae (*Enteromorpha, Ulva, Porphyra, Gigartina, Hesperophycus*)	observed damaged by various intertidal investigators
All Rocky intertidal organisms (including Santa Barbara Harbor)	affected by clean up activities
Shallow Subtidal Zone	
Subtidal benthic organisms in Santa Barbara Harbor	
Neritic Habitat	
California Sea Lions (*Zalophus californianus*)	

The following are observations made during studies of the Santa Barbara blowout by various authors: (1) the barnacles *(Chthamalus fissus, Balanus glandula, Pollicipes polymerus)*, and possibly the mussel *Mytilus californianus* either had a lag in their setting season or had a reduction in the fraction of adults breeding on polluted areas (Straughan, 1971a). (2) Straughan, (ibid) noted that oil does not get a chance to dry out on the lower intertidal where stalked barnacles *(P. polymerus)* reaches its greatest abundance. This may cause a greater exposure to toxic chemicals released from the oils through feeding. The greatest destruction occurred, however, on the upper intertidal, especially in tide pools, where oil apparently smothered the shorter *Chthamalus,* but left *Balanus* relatively unharmed because the oil did not completely cover them. (3) Destruction of the intertidal species killed was not permanent because their distribution was broad enough to allow them to repopulate from other breeding areas (ibid). (4) It appeared to Foster et al. (1971) that the overall damage was definitely related to the initial dose of oil. Had the oil reached shore immediately after the blowout, damage would have been far greater. (5) The leaves of the intertidal surf grass (*Phyllospodix* spp.) were killed because they lack a mucoid covering which is present on the apparently unharmed kelp and other algae (ibid). (6) Cleaning of rocky shores with jets of hot water, not only killed organisims in direct contact of the spray, but caused air dried oil to liquify and run down to lower intertidal levels where additional organisims were killed (ibid). (7) Cleanup methods were far less destructive than the use of detergents would have been. (8) Foster (1974) believed that many more organisms on the leaves of surf grass and in intertidal crevices were killed than were reported. (9) The wavy top shell, *(Astrea undosa)* was reported by (Seeley, in Battelle, 1970) as dead or dying on the sand on Carpenteria State Beach. Although covered by oil, they were apparently killed by fresh water. (10) The unusually heavy rainfall of the winter of 1969 unquestionably reduced salinities on the intertidal, complicating impact evaluations. We, however, could find no reported intertidal salinity data for the month of February 1969. The winter of 1973 was another rainy year and Straughan (1973) reported salinities as low as 2 to 6^{o}/oo on the lower intertidal at Ellwood Beach and as low as 24^{o}/oo in the surf of North Carpenteria Beach and 20^{o}/oo at Ellwood.

Most pollution studies for the littoral zone are concerned with rocky shorelines of New England and California and their characteristic assemblages of seaweeds, barnacles, limpets, anemones, etc., rather than for sandy beach communities, composed of other invertebrate species which have not been as extensively studied in relation to oil and oil spills.

Trask (1971) studied the effect of oil on sandy beaches during the Santa Barbara oil spill. However, because of a lack of a previous baseline study and because there is far less sand and therefore organisms on the beaches during the winter (the time for the spill) he could form no definite conclusions.

By the time the oil reached the beaches, the lighter fractions had evaporated and the oil was too heavy to penetrate into the sand (Straughan, 1972). This coupled with the low winter community population and sparseness of sand on the beaches unquestionably prevented greater loss of the beach community.

Chan (1972) reported a sharp reduction of fauna on a sandy beach oiled during the San Francisco Bay oil spill occurred 3 months after the spill. A nearby beach which had not received oil during the spill also experienced a similar reduction, however. The oil spill could not be implicated for the population reduction.

To generalize, where organisms have been covered by crude oil and Bunker C fuel oil, death is primarily blamed on smothering due to physical coating (e.g. Chan, 1972; Nicholson and Climberg, 1971). When the pollutant has been a lighter refined fuel oil, mortalities and stress have been primarily associated with toxic effects of the oil (e.g. North, Neushul and Clendenning, 1964).

In the event of a major spill beach communities may be expected to suffer considerable localized damage.

Repopulation will begin as soon as the oil clears from the substrate sufficiently to allow setting, but return to pre-spill conditions at completely decimated areas will depend upon the time required to establish a sexually breeding population of sessile species. In the case of the stalked barnacle, *(Pollicipes polymerus)* the time will be 5 years (Straughan, 1971a).

Newell (1948) and Valentine (1966) suggested that a significant number of endemic molluscs, some with a distribution restricted to 1° latitude, occur within the California Bight. This endemism also occurs in other taxonomic groups (Newman, personnal communication, 1974). The implication of this is obvious; severe or chronic alteration of comparable areas of the environment could eliminate endemic species forever. It is conceivable that a large spill could eliminate a sensitive rare endemic with a restricted geographical range from the Bight area. Conversely, extinction may not occur because, (1) intertidal organisms tend to be eurytopic and tolerant to many environmental stresses and (2) some of the more sensitive endemics may have already been eliminated from other forms of pollution or alterations. The effect of wide-spread chronic oil pollution or a large oil spill in combination with other types of environmental alterations is not known, but could conceivably contribute to the extinction of some of these endemics.

The impact from drilling and pipeline operations on intertidal communities is expected to be slight except at the actual site where a pipeline goes ashore. Here almost complete destruction of the intertidal community in a zone 5 to 10 feet along either side of the pipeline will be destroyed. There is not expected to be any long term damage to the community. Perhaps the potentially most dangerous impact would be from intertidal sedimentation from polluted sediments stirred up during pipeline laying. The consequence of this, although believed to be minor in relationship to the total of intertidal communities, is not known. As indicated before, this impact is most likely to occur around the Los Angeles area.

Marine vegetation in the intertidal area will be primarily affected by impacts caused by accidental and chronic oil spills and any associated use of chemical dispersants. Other effects could result from turbidity and disruption impacts from pipeline excavation and construction of onshore facilities along the coast.

Marine vegetation as discussed in Section II.E.3.a. includes eelgrass and the attached algae such as kelps, rockweeds, red algae, green algae, and surf grass. The higher the concentrations of low-boiling compounds, unsaturated compounds, aromatics and acids in oil, the more toxic they are to plants (Baker, 1970). Oil deleteriously affects plants by damaging cell membranes, reducing transpiration, often increasing respiration, inhibiting translocation and possibly reducing photosynthesis.

Studies of salt marsh vegetation in Milford Haven (Cowell, 1971) have revealed that it may be damaged by exposure to crude oil, although treatment measures may induce more damage (Anonymous, 1970). British investigators have attributed the disappearance of eel grass (*Zostera* sp.) to minute quantities of oil (FWQA, 1969). The FWQA (Federal Water Quality Administration) report states that oil weakens the plant and makes it susceptible to attacks of a parasitic fungus *Labyrinthula*. On the Brittany coast, *Puccinellia maritima*, one of the chief types of European salt marsh grass, and several other varieties of salt marsh grass were killed by MV Torrey Canyon oil that had been weathered at sea for at least seven days (McCaull, 1969). The oil that came ashore on the Brittany coast was considered to be free of detergent and to have weathered for 24 days (Smith, 1968). Holme (1969) attributed much of the destruction of the vegetation and invertebrate life from this spill to smothering.

The fuel oil spill of the barge Florida in Massachusetts (Blumer and others, 1970) killed bottom plants and animals, thereby reducing the stability of the marshland and increasing erosion. Even chronic level pollution can kill vegetation, resulting in erosion of marshes (Cowell, 1971).

Further impacts of oil pollution on marine vegetation have been summarized by Nelson-Smith (1973). Seaweeds can suffer damage over a considerable area without losing their capacity to recover. The large brown algae of temperate-zone shores are covered with a mucilaginous slime which is not readily penetrated by fresh, thin oil.

As fresh crude oil from Platform A approached the shore of the Santa Barbara Channel, offshore beds of the giant kelp (*Macrocystis phyrifera*) protected plants and animals of the lower intertidal by holding it back until the tide rose over them (Nicholson and Cimberg, 1971). It then washed readily off the kelp blades. Most algae can survive oiling (Smith, 1968), but the small *Hesperophycus harveyanus* became so heavily encrusted around the islands off Santa Barbara that oil-laden plants were broken off by waves which denuded some areas (California Department of Fish and Game, 1969). Some Puerto Rican shores were denuded of algae after the "Argea Prima" spill. Diaz-Piferrer (1962) and Spooner (1971) observed similar damage to fucoids overweighted by very thick oil from the "Arrow" spill in Nova Scotia.

Nicholson and Cimberg (1971) compared the flora of Southern California beaches after the 1969 Santa Barbara blowout with that revealed by surveys made 12-15 years earlier and found an average reduction of 63% in the number of algal species. Greatest losses were observed to be red algae. However, it is difficult to directly relate the reduction of algae species over that time period to the Santa Barbara blowout. Many other environmental factors and natural fluctuations could have contributed to the reduction. Domestic sewage, collection of specimens or trampling by seashore visitors were also possible causes of the reduction.

In an earlier study reported by the Allan Hancock Foundation (1965), Dawson found a reduction in algal species and a change in the dominant species near sewage outfalls of the Los Angeles area (see Section II.E.3.a.). Red algae also suffered the greatest damage during the "Torrey Canyon" spill and from the diesel-oil spill around "Tampico Maru."

Oil pollution can inhibit photosynthetic activity in some algae. North et al. (1964) investigated the toxicity of diesel oil and found that a 0.1% emulsion nearly inhibits all photosynthetic activity of young *Macrocystis* blades. Clendenning and North (1960) observed that 10-100 ppm of fuel oils caused a 50% reduction in photosynthetic activity of algae in four days.

However, some species of blue-green algae resist oil pollution and actually thrive under such conditions. Diaz-Piferrer (1962), Spooner (1970), Baker (1971), and Cabioch (1971) recorded blue-green algae around refinery outfalls.

A recent review of the literature by CEQ (1974) reported a toxicity range of 10-100 ppm of soluble aromatic hydrocarbons for marine flora. Templeton (1972, as cited by AEIDC/ISEGR 1974) stated that plants covered with oil produce new shoots unless the plant bases and surrounding soil have become contaminated. However, individual seedlings and annuals rarely recover. Chan (1975) discussed results from the effects of the 1971 San Francisco oil spill on marine plants and invertebrates. Eight hundred and forty thousand gallons of Bunker C oil were spilled by tanker collision. He observed that the surf grass (*Phyllospadix* sp.) and other upper-zoned algae suffered die-offs at the tips of some plants, but that they grew back by one year after the spill. Clark et al. (1975)

also noted effects on *Phyllospadix* sp. from oil spilled by a troopship wreck off Cape Flattery, Washington on January 9, 1972. *Phyllospadix* sp. was heavily oiled and absorbed great quantities of oil. One month after the spill, 41% of the dry weight of the plants was oil. Some plants of *Fucus* sp. (rockweed) were unhealthy one month after the spill but six months later their hydrocarbon levels were indistinguishable from baseline levels. Clark et al. (1975) observed no significant differences in the populations from March 1972 to August 1974 outside of seasonal variations. The populations seemed to return to normal by August 1974 and no significant long-term effects were noted.

Various species of marine algae have been tested for effects on photosynthesis from Prudhoe Bay crude oil in concentrations of 0.003-10 ppm, or the expected concentration range from treated tanker ballast-water discharge. Some of the results are reported below as taken from Shiels et al. (1973):

> Seaweed oil-toxicity experiments, in which the ^{14}C method was used to measure photosynthesis, indicated no pattern that was common to all species. Photosynthetic inhibition was indicated for *Cladophora stimpsonii, Ulva fenestrata* and *Laminaria saccharina* at 7 ppm crude oil, whereas other species were not significantly affected at this concentration. Photosynthetic stimulation was noted for several algae at different concentrations (~80-percent photosynthetic increase by *Ulva* and *Alaria* at 0.7 ppm crude oil; ~30-percent increase *Costaria* at 0.007 ppm). *Enteromorpha intestinalis* showed an 80-percent reduction in oxygen production when exposed to 10-12 ppm oil.
>
> The marine plant populations in Port Valdez, Alaska, showed varied photosynthetic responses to crude oil contamination. These responses seemed to result from a complex interaction of several physical, chemical and biological factors that can apparently act in either an adverse or beneficial way.
>
> Seaweed toxicity experiments conducted in this study were limited by the length of exposure time (2-4 hours)

> and the absence of information on the toxic effects of oil to reproductive forms of the algae such as gametes and zoospores. Since the protective covering of mucilage typical of mature plants is often absent in reproductive forms, severe damage to a seaweed population could occur if seawater were polluted by oil during the time of year when gametes are released.

The impact of increased turbidity from pipeline excavation, burial, and dredging on marine vegetation would probably be minimal. A temporary reduction in sunlight penetration would reduce plant growth and production but long-term growth and production should not be significantly affected. A more adverse effect would be from disruption and removal of habitat from nearshore and onshore pipelaying, and construction of onshore facilities. Damage could be permanent or populations could take up to several growing seasons to recover fully. The extent of this impact would depend on where this activity occurred. Marshlands and large beds of eelgrass or surf grass in quiet lagoons would be among the most vulnerable habitats.

Artificial substrate and particularly the common hard bottom communities have received some attention in several studies. Communities of animals on artificial substrates are common along the jetties and pilings which protect the entrances to harbors and along the numerous pilings and boat docking structures distributed along the coast. They are also found on oil drilling and producing structures.

Studying the effects of the Chedabucto Bay spill of Bunker C oil, Thomas (1973) found that most of the 20 species of animals observed suffered from the effects of coating with subsequent smothering of animals but were otherwise little affected. Barnacles showed no unusual mortalities and settlement of larvae occurred in following seasons.

Periwinkles, common intertidal mollusks, remained abundant and continued to occupy the same general zones. A seaweed, *Fucus*, however, declined over the next ten months and, where oiling was severe, recolonization had not been successful at the time of publication (1973). Attached seaweed which declined as a result of contact with petroleum hydrocarbons dispersed from the Torrey Canyon, later recovered in the absence of grazing organisms.

Anderson et al. (1969) reported a 20% mortality of barnacles and evidence of recent mortalities among kelp bed pectens on Platform A during the Santa Barbara oil blowout. No other evidence of mortality was noted on the platform.

In summary, impacts from drilling and pipeline laying will be relatively minor. The damage from a large case 1 (large spill scenarios, Section III.B.) oil spill could be severe to the rocky shore intertidal. Smothering should cause the principal damage to specific upper intertidal species of plants and animals where all individuals oiled will die. The toxic effect from crude oil reaching shore in three or four hours is unknown, but will not be as severe as is caused by refined oil spills. Although the entire intertidal community will not be killed, many individuals of a variety of species will be. Reproduction and repopulation will be retarded for several months, and the extinction of rare endemics is a possibility. Biological recovery will take up to five years.

Prior to the resettlement by the decimated invertebrate populations, their area of the intertidal will be covered with a rich luxuriant growth of algae. The algae domination will probably be replaced by the normal dominating invertebrate species within a year. However, the time required for the decimated intertidal community to return to prespill conditions is unknown.

Photosynthesis of some intertidal and subtidal species would be inhibited while others would be enhanced at low hydrocarbon concentrations. Seasonally the vegetation would be most vulnerable in the primary growing season during spring and early summer. Any dispersants or chemicals used to clean up oil on the shore would probably increase the damage to the plant communities.

The effects of chronic long-term oil pollution on the marine vegetation are unknown. An estimated 3,820-43,606 bbl of oil per year will be discharged into the proposed lease area from all sources. This discharge would continue throughout the production life of the area (25-40 years). Long-term effects could be a decrease in productivity and a decrease in species diversity. The extent of these effects is unknown.

Turbidity effects as discussed above would be minimal. Disruption and removal of habitat from pipeline excavation and onshore facility construction would be significant only in areas of large eelgrass and seaweed beds. Heavy growth of intertidal seaweed is present on the rocky shores of the offshore islands. As mentioned in Section II.E.3.a., marine macrophyte vegetation is very important in the subtidal and intertidal ecology of the coast. Seaweeds provide animal habitats for many species, substrates for fish and invertebrate egg deposits, protective nursery areas for young, and serve as a direct food source.

The extent of the damage to a sandy beach intertidal community will be less than that to a rocky shore community. The extent of the damage from a Case 1 spill is unknown but is not expected to be the complete destruction of a community. Cleanup operations of intertidal areas could cause total destruction of the rocky shore communities and significantly harm the communities of the sandy beach areas actually cleaned. It seems unlikely that much biological damage would result from oil covering the maximum shoreline projected in Section III.B., but considering the minimum area covered, there is a probability that large proportions of the populations of certain species will be destroyed throughout the six to seven miles of beaches that have been heavily covered by oil. Quantification beyond this is impossible.

The impact of a small (see scenarios, Section III.B.) 500 barrel spill will probably be negligible. Frequent small spills, however, could cause an impact, the extent of which is unknown.

3. Impact on Bird Life

A discussion of the diverse California Birdlife may be found in Section II.I.3.

The magnitude of the effects of oil pollution on bird life is impossible to accurately determine because of the many variables involved. Oil does pose a serious threat to bird resources. Some of the effects and variables are discussed below.

Effect of Oil Pollution at Sea on Birds

Erickson (1963) noted that oil pollution may serve as an agent of intermittent but continuing attrition, especially on those migrant birds using coastal and offshore waters. Most pollution-caused losses occur during the coldest months when the birds are abundant along the coast and are concentrated at stopover points or on the wintering grounds. Losses under these circustances may be especially important because they may affect birds which have already survied the southward flight and hunting season, and have become the remaining potential breeding stock for the next nesting season.

Damage caused to seabirds by oil pollution is often obscure because it is difficult to detect when birds are lost from more distant populations and because the effect may be widely spread and difficult to distinguish from other causes of mortality (Bourne, 1970). The affinities between wintering and breeding areas and migration routes for most populations of seabirds are mostly either unknown or based on speculation. Better information is available for some populations of waterfowl because of extensive bandings and relatively high recovery rates of bands for some species.

The following discussion of the documented effects of oil pollution on birds includes estimates of mortality which are considered to be low. This is because the estimates are based primarily on beach counts of oiled birds and such counts are low for several reasons. Scavenging foxes and gulls quickly remove some carcasses and others are either tossed high upon the shore or buried in sand. Circumstantial evidence suggests that from 50 percent to 91 percent of the birds killed at sea may never wash ashore (Jones et. al. 1970; Tanis and Marzer Bruyns, 1968); but, rather, they sink or are eaten by gulls and fish. Additionally, birds may either die some distance from the site of oiling or, as later discussed, they may be reproductively impaired.

During February and March 1970, at least 10,000 birds were killed by oil apparently derived from ballast pumped from tankers entering Cook Inlet, Alaska, in what was referred to as the "Kodiak Oil Spill" (U. S. Department of the Interior, 1970).[1] No surveys were made to assess the mortality and only 29 oil-killed birds were identified to species. Alcids, seaducks, gulls and kittiwakes were known to be killed;

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[1] This mortality should not be confused with one on Bristol Bay during April, 1970, which involved at least 86,000 murres. Though not clearly understood, that mortality was perhaps attributable to the combined effects of a severe storm upon birds weakened by the winter period (J. C. Bartonek, personal observation, 1970).

other species were suspected to have been involved by virtue of their presence within the polluted area. James G. King (Personal communications to Regional Director, BSFW, Portland, Oregon, from J. G. King, 1970) believed that the kill was perhaps 10 times the announced 10,000 birds, because of his observations on the duration of the pollution and on the fact that oil was also found at the lower end of the Kenai Peninsula and on Montague Island immediately followiing the reported kills at Kodiak. This essentially doubled the 1,000 miles of shoreline originally believed to have been contaminated and thereby presumably doubled the estimate of birds killed. The exact source and volume of oil involved are not known.

On October 5, 1968, the day following reports of waterfowl in trouble near Homer, Alaska, aerial surveys along both shores of Cook Inlet between Anchorage and Homer found many dead or dying guillemots and murres and between 250 and 350 ducks that were covered with oil (Anonymous, 1968). Sources and volume of oil involved are not known.

On seven days between November 22 and December 8, 1967, the Environmental Protection Agency (no date) logged that oil pollution, presumably from oil ballast, killed ducks within Cook Inlet, Alaska. An estimated 1,800 to 2,000 seaducks and other waterbirds were killed (Evans, 1969). Volume and exact source of oil are not known.

The West Coast of the United States has had a number of recorded bird kills from oil spills. On January 18, 1971, two tankers collided in San Francisco Bay and lost 840,000 gallons of bunker oil, which killed many thousands of birds (Lassen, 1971). Included in the 4,557 birds identified at receiving stations were: western grebe 55.7 percent, other grebes

2.5 percent, scoters 22.5 percent, other ducks 2.8 percent, common murres 9.8 percent, loons 4.1 percent, and less than 1 percent each for cormorants, gulls, American coots and miscellaneous species (Wallace, 1971).

On September 6, 1956, the freighter "Seagate" lost an unknown amount of bunker fuel after running aground near Point Grenville off the Washington coast. A week later, searches for oil-killed birds along four stretches of beach, all but one a mile or more in length, found an average of 132 white-winged scoters and 56 common murres per mile of beach, with lesser numbers of red-necked grebes, common loons, pelagic cormorants and one each pigeon, guillemot, marbled murrelet, and surf scoter (Richardson, 1956). Although the kill was believed to have been more severe to the north rather than to the south of the accident site (Richardson, 1956), LaFave (1957), two weeks after the spill, reported finding 36 white-winged scoters, 21 surf scoters, and 70 murres, dead and presumably killed by oil, along a measured mile of beach in Grays Harbor, nearly 25 miles to the south.

In 1937 an unknown volume of oil from a tanker in San Francisco Bay contaminated 55 miles of shoreline and killed more than 10,000 birds, over 60 percent of which were murres with many western grebes and white-winged scoters also perishing (Aldrich, 1938; Moffitt and Orr, 1938).

The eastern coast of North America also has numerous examples of oil spills and resulting bird losses. From February to April 1970 there were an estimated six oil slicks from four sources drifting off the coasts of southern Newfoundland and eastern Nova Scotia. The majority of this oil came from the wrecked tanker "Arrow" and the leaking oil barge "Irving Whale" and killed at least 12,800 birds, mostly alcids and eider ducks, before drifting out to sea (Brown, 1970).

According to Tuck (1960) oil pollution is the greatest cause of mortality to thick-billed murres and common murres wintering off Newfoundland where many great circle routes of ocean-going vessels converge. Winds and currents bring dumped and lost oil shorewards causing heavy losses of murres, eider ducks and other seabirds. Although losses occur throughout the year, they are greatest in winter when eider ducks concentrate inshore and murres offshore.

Dennis (1959), as part of an oil pollution survey, records a loss of 7,500 birds, 80 percent of which were eiders, on the shore of Nantucket in 1956.

Burnett and Snyder (1954) observed a decline in the wintering population of common eiders off the Massachusetts coast from 500,000 in 1952 to 150,000 in 1953 and attributed it in part to losses resulting from oil spilled by two wrecked tankers in February 1952.

The history of marine oil transport throughout the world includes many oil spills (Bourne, 1969). A few of the major ones in recent years are mentioned here as additional background. Statistics from the Liverpool Underwriters Association list 19 tanker groundings (with 17 spillages) and 238 tanker collisions (with 22 spillages) from June 1964 to April 1967 (Aldrich, 1970).

According to the Smithsonian Institution Center for Short-Lived Phenomena, 15,000 to 25,000 oil-affected eiders came ashore on the Wadden Islands, Netherlands, in February 1969 (Aldrich, 1970).

Oil spilled from the wrecked tanker "Torrey Canyon" in March 1967 off the coast of England killed many tens of thousands of birds. Nearly

8,000 birds were picked up still alive on the English coast alone for attempted rehabilitation (Bourne, 1970).

When the "Gerd Maersk" was stranded off the mouth of the Elbe River in January 1955, at least 500,000 birds of 19 species were killed, the most abundant being common scoters (Goethe, 1968).

Straughan (1971) discussed the loss of birds as a result of the Santa Barbara oil blowout in January 1969. The California Department of Fish and Game conducted aerial and beach surveys of 1,075 square miles of affected area between February 5 and March 31, 1969. They estimated a population of 12,000 birds for the study area and observed no unusual movements of birds during this period. A second survey was carried out between April 1 and May 31, 1969. The estimated population at this time was 85,000 resulting from significant influxes of pelagic species.

Beach transects were established along 5.7 miles of beach area, of which 4.8 miles was oil contaminated. A daily average of 439 birds were observed; 290 of these being within the oil contaminated area. A total of 70 dead birds were recorded in the transect area. On the basis of the transect data, bird losses for the 75.7 miles of beach from Point Conception to the mouth of the Ventura River were estimated to be 1,603. Added to this were 1,388 which died after treatment, 175 turned into the treatment stations dead, and 439 reported from other sources outside the study area. As of May 31, 1969 known bird losses totaled 3,686. This total did not include the unknown number of birds lost on the open water which failed to drift ashore.

Bourne (1968), stated that the effects of oil on the various species of birds is usually related to their varying behavior patterns. Aerial species (e.g. gulls, terns) are unlikely to plunge into oil deliberately, and coastal species (e.g. sandpipers, plovers) may paddle over it or squat in it on shore, usually without any major effects. However, swimming species such as loans and grebes are compelled to bathe in it.

Bird losses due to oil pollution have suppressed some local populations for prolonged periods. Uspenskii (1964) reported that more than 30,000 wintering oldsquaws perished from oil pollution near Gotland Island in the Baltic and that in subsequent years, oldsquaws had almost completely disappeared from Swedish Lapland.

Effect of Oil on Birds and Their Habitat

Birds are killed by oil on water. Some survive the contamination, but are discomforted and probably reduced in reproductive capability. The extent of oiling, type of oil, and the prevailing weather conditions usually determine the fate of these birds.

The immediate effect of oil is on the birds' plumage. According to Clark (1969), feathers become matted together, destroying the water-repellant property of the plumage and allowing water to replace the air normally trapped in it. When the plumage becomes oil-soaked and water-logged, birds lost buoyancy and the ability to fly (Erickson, 1963), and diving ducks are unable to dive for food (Chubb, 1954). Taning (in Tuck 1960) reported seeing oil-affected alcids far out at sea, so soaked with water that they could keep only their head and neck above the surface. Some birds drown and are never swept ashore.

Experimentally oiled ducks greatly increase their metabolic rates to compensate for heat lost because of a breakdown of the insulating properties of the plumage, with heavily oiled ducks losing more than twice the heat of normal ducks (Hartung, 1967). Because oiled ducks either do not or can not increase their feeding activity to compensate for the increased energy demands and because their fat reserves, if any, are quickly depleted, they suffer from accelerated starvation. Accelerated starvation during periods of low temperatures is usually fatal for most waterbirds. Tuck (1960) claimed that a patch of oil, one inch in diameter, on the belly of a murre was sufficient to destroy the insulating air pocket and cause death from exposure to the chilling effect of the sea.

Sticky globs of oil were found on the beaches of Kodiak Island following the oiling of birds there in February and March of 1970, and James G. King (Personal communication to Regional Director, BSFW, Portland, Oregon, from J. G. King, 1970) speculated that this oil could kill birds by adhering to their bills, mouths, and nares and thus fatally impair breathing and feeding.

Although the relative toxicity of Southern California crude oil to birds is not known, many refined petroleum materials are known to be lethally toxic to waterbirds. Hartung and Hunt (1966) demonstrated that various industrial oils caused lipid pneumonia, gastro-intestinal irritation, fatty livers, and adrenal cortical hyperplasia when fed to ducks in single doses that were regarded to be less than that which might be ingested during preening of oiled plumages. Although the toxicity varied among the oils tested, all oils were more toxic mallards continued incubating their clutches of unviable eggs for longer than normal periods (Hartung, 1965). The prolonged and unsuccessful incubation period would prevent birds which otherwise may be capable of renesting from attempting to renest. Renesting by many species of waterfowl is seldom either attempted or successful in the more northern latitudes; therefore, the success or failure of the first nesting attempt usually determines the outcome of that year's production.

The long-term damage to bird habitat from chronic oil pollution at sea may exceed that caused by irregularly occurring major spills. Murphy (1971) summarized the accumulating evidence which suggests that discharged oil may not degrade as rapidly and completely as previously assumed, and argued that many harmful hydrocarbons, such as the carcinogenic ones, may persist in the marine environment and exert cumulative effects.

According to Erickson (1963):

> Migratory birds are indirectly affected by deposits of oil which reduce the available food supply of both plant and animal matter, on the bottom, in shallow water, or along the shore. Various elements in the food chains are eliminated by chemical and physical properties of the oil, or items of the diet may be made unavailable by being overlaid or imbedded in tarry materials. The use of important feeding grounds has declined greatly after pollution by oil, either because of the elimination of essential food and cover, or because fouling of the habitat in other ways had reduced the attractiveness of the areas. Many shorebirds which rely upon the intertidal zones for feeding may find them completely blanketed with oil.

Nature of Contamination

Groups believed to be the most susceptible to contamination by oil are: murres, guillemots, auklets, murrelets, puffins, cormorants, loons, grebes, and scoters. Shearwaters, fulmars, albatrosses, petrels, gulls, terns, shorebirds and some ducks and geese are also vulnerable when the captive ducks were under stress from crowding and low temperatures. Beer (1968) observed comparable necrotic conditions among alcids retrieved from the "Torrey Canyon" spill. Some components of crude oils are carcinogenic (Blumer, 1969).

Stress is unlikely to be directly responsible for the deaths of birds, but it is an important contributing factor (Clark, 1969). All of the combined effects of cold, starvation, toxic effects of oil, disturbance, internal injury and, presumably, fright combine to cause acute stress. The bird's resistance to secondary infections and the toxic effects of oil are reduced, often beyond the threshold of recovery. Birds under stress are also probably more vulnerable to predation than healthy birds.

Some waterbirds that become contaminated with nonlethal doses of petroleum during the breeding season are not likely to contribute to the annual production. Hartung (1965) found that ducks which had been fed small doses of a relatively non-toxic, lubricant oil stopped laying for about two weeks, while "control" ducks continued to lay normally. Such disruptions of nesting in the higher latitudes where the growing season is short are sufficient to cause complete nesting failure among brant (Barry, 1962), geese (Ryder, 1967) and, probably, other birds.

The viability of embryos is greatly reduced when the eggshell becomes smeared with oil from the contaminated plumage of the female. Hartung (1965) recorded only 21 percent hatching success among a group of mallard eggs that had been lightly coated with medicinal mineral oil vs. 80 percent for unoiled mallard eggs. Experimentally oiled female to contamination at sea but less so than divers.

Some bird species are more vulnerable to oil than others as indicated by records of casualties (Clark and Kennedy, 1968; Bourne, 1968b; Wallace, 1971) which show good relationships between the amount of time that a species spends in the water and the frequency of contamination (Erickson, 1963). In Great Britain (Bourne and Devlin, 1969) oil has had its main impact on a limited number of diving birds which are already known to be decreasing, including, especially the auks and common scoter. Although a considerable number of gulls are affected, their mortality rate appears to be much lower, presumably because they seldom become as soaked with oil as alcids and because they do not stay on the water to get chilled afterwards.

Bourne and Devlin (1969) believe that the main mortality from oil pollution arises because birds on the water are trapped unawares by long slicks drifting toward them. Presumably once the birds are caught in the oil they drift with it until they starve to death and their bodies either sink or wash ashore days later.

According to Bourne (1968a), suggestions that birds positively seek out oil because it makes the water calm, or resembles food, or tide-rips, or shoaling fish associated with the presence of food, seem to be based chiefly on speculation. He observed swimming birds not taking notice of a drifting, narrow slick of oil until they came in contact with it. Upon contact, gulls flew away and murres dived beneath the slick. The diving behavior of alcids to escape danger would probably be fatal if they rose from the dive into the slick, such as was believed to have been the case for most alcids killed during the "Torrey Canyon" disaster.

Birds that concentrate and feed along current convergence lines may be susceptible to contamination by oil. Evans (1969) found that some spilled oil in Cook Inlet, Alaska, collected within and attached to the windrowed vegetation and debris that occurs along convergence lines; he believed that that oil would float about on tidal currents for an extended period.

Rehabilitation of Oiled Birds

Aldrich (1970) reviewed the problem of rehabilitation of oiled birds and reached the following conclusions;

1. Oil of varying sorts can be cleaned from the plumage of birds with several kinds of cleaners, but so far there is no convincing evidence that the natural water repelling qualities can be restored to the cleaned feathers by known means. The only cases where birds cleaned of oil have apparently been successfully returned to the wild are those in which the birds had been held in captivity through the annual molt.

2. Curing oiled birds of the original toxic effects of ingested oil and of the ills developing from rehabilitation is basic to the success of any salvage effort and must be perfected for each species concerned.

3. Aside from the special pathological problems resulting from the initial poisoning and exposure, soiling of the feathers by oil, and the problem of restoring waterproofing to the plumage, the problems involved in the care of cleaned oiled birds are largely avicultural. Their difficulty depends on the reactions of different species of birds to captive conditions and the knowledge of the aviculturist about the requirements of any one species in capitivity.

So much uncertainty surrounded the estimates of success in "rehabilitating" birds from the "Torrey Canyon" disaster that Clark and Kennedy (1971) restricted their evaluation of the treatments up to the time of release, even though this gave an "over-optimistic" view of the situation. Treatment methods were generally unsuccessful, with only 450 of at least 7,848 oiled birds for which records were maintained surviving one month following treatment, for an initial survival rate of 5.7 percent. Bourne (1970) calculated that only 0.2 - 0.4 percent survived to be returned to the sea where at least 25 percent were soon found dead under conditions where the recovery rate was poor. He concluded that it was unlikely that the rehabilitation rate reached 0.25 percent and it could well have been much less.

The small numbers of oiled birds surviving the rehabilitation efforts following the collision of the "Arizona Standard" with the "Oregon Standard" in San Francisco Bay in 1971 suggests that little progress has been made with methods since the "Torrey Canyon" spills in 1967. Of the estimated 7,000 dead and dying birds that were brought to cleaning stations in mid-January 1971, some 200 were still alive in late May and over 50 had been released (Wallace, 1971), with only from a fifth to a quarter of those being treated surviving more than 10 days (Lassen, 1971).

The types of impact resulting from a case 1 or case 2 large spill would be similar to those outlined above. A case 1 spill moving steadily onshore at from 0.75 to 1 MPH would tend to have a greater impact upon near shore and shorebird species than normal. By reaching shore in 3.5 to 4 hours, the more toxic elements of the crude oil would still be present causing high fatality through direct ingestion and greater irritability to surface wounds, eyes, and respiratory passages. The faster moving slick would tend to reach higher up on the beach area because of the onshore wind pushing it along. This would mean that bird habitats of low lying intertidal areas would become coated with oil resulting in the loss of food sources, nests and nesting sites, and any incubating eggs that become coated with oil. Such inshore species as eider ducks and shorebirds would become coated with oil and perish from starvation and loss of thermoregulatory capabilities. The case 1 slick would tend to affect fewer pelagic species because of its limited area, due to relatively rapid movement onshore. Those pelagic species that come into contact with the oil slick would become coated with oil and lose their thermoregulatory capacity, buoyancy, flight capability and ability to feed.

The case 2 spill would have the same effects but would affect a greater number of pelagic birds because of its larger surface area and longer time in the open sea. It would also affect a greater number of shorebirds because of its greater area, although most of the more toxic components of the crude oil would have dissipated.

It is impossible to predict the number of birds or species that would be affected by an oil slick because of the numerous associated factors that come into play. The time of day, season of the year, sea conditions, weather, and so on, all play a part in the effect of a spill. A summer spill would have a greater affect on many shorebirds which are nesting along the coast at this time, while a fall-winter spill would probably affect a greater variety species and a greater number of birds because of the higher number of overwintering birds.

4. Impact on Channel Islands

When compared to the adjacent metropolitan sprawl of Southern California, the Channel Islands are wild, remote and comparatively inaccessable. Beyond military occupation and the city of Avalon on Santa Catalina Island, they bear few marks of man's presence. Man has been there and is still there as evidenced by goat overgrazing on San Clemente, rat infestation on Anacapa, cattle grazing on Santa Rosa and Santa Cruz and rabbit over population on Santa Barbara. But by and large man is a transient through week-end boating and fishing activities.

The United States has but a fixed total of relatively unexploited land area. It is a scarce and disappearing resource, part of our natural heritage, and is reduced each year by man's constant encroachment. For a complete discussion of The Channel Islands see Section II.F.3.

Oil and gas development within the proposed lease areas would impact directly on the Channel Islands and their associated biota through increased human activity and physical use of the islands as indicated in WOGA's own environmental statement (Vol.1, Section II.B, page 48).

"For the more distant operations, it would be most desirable to use selected Channel Islands for supply and equipment storage, embarking of personnel, crude processing and storage, gas processing, and field headquarters. Inboard of Santa Catalina and Santa Barbara Islands, the mainland would be the logical choice for such installations.... The U. S. Navy has been approached by industry to use San Clemente and San Nicholas Islands for supporting offshore oil operations."

Parts of the island's environment which would be impacted are archaeological artifacts, marine vegetation, terrestrial vegetation, terrestrial mammals, intertidal areas, birds, and marine mammals.

Archaeology

The extent of impact on the archaeological and paleontological resources on the islands is not known and cannot be assessed until any possible pipeline right-of-way or supply staging area is chosen. The islands are rich in archaeological and paleontological artifacts. Orr (1968) states, that over a period of 21 years, 200 ancient village sites have been identified on Santa Rosa Island; Rozaire (1967) states that the Channel Islands give evidence of having been among the most heavily populated areas in aboriginal North America.

The effect of development projects on archaeological resources would be an adverse impact and would represent an irreversible commitment of those resources. Many sites will undoubtedly be located during clearing and construction activities, but many could also be destroyed or badly compromised before their existence was realized. Provision for archaeological excavation does not therefore eliminate the adverse impact. It is only a means of lessening the impact.

Valuable artifacts could be found and pocketed by construction workers and others. When construction occurs in archaeologically and paleontologically rich areas, a method for reporting all finds should be instituted. The presence of an archeologist or anthropologist would assist the workers in identifying artifacts and in cataloging the finds.

Access roads present another threat to antiquities. Valuable archaeological areas might become accessible to the public. Artifact digging and collecting in important areas would comprise or destroy scientific data that otherwise might advance the knowledge of early California cultures.

Marine Vegetation

The higher the concentrations of low-boiling compounds, unsaturated compounds, aromatics and acids in oil, the more toxic it is to plants (Baker, 1970). Oil deleteriously affects plants by damaging cell membranes reducing transpiration, often increasing respiration, inhibiting trans-location and possibly reducing photosynthesis.

Studies of salt marsh vegetation in Milford Haven have revealed that it may be damaged by exposure to crude oil, although treatment measures may induce more damage (Anonymous, 1970). British investigators have attributed the disappearance of eel grass *(Zostera* sp.) to minute quantities of oil (FWQA, 1969, p. 46). The FWQA report states that oil weakens the plant and makes it susceptible to attacks of a parasitic protozoan *Labyrinthula*. Cowell (1971), reviews some of the effects of oil-spillage on marsh vegetation in Milford Haven.

On the Brittany coast, *Puccinellia maritima,* one of the chief types of European salt marsh grass, and several other varieties of salt marsh grass were killed by MV Torrey Canyon oil that had been weathered at sea for at least 7 days (McCaull, 1969). The oil that came ashore on Brittany coast was considered to be free of detergent and to have weathered for 24 days (Smith, 1968, p. 67). Holme (1969) attributed much of the destruction of the vegetation and invertebrate life from this spill to smothering.

The fuel oil spill of the barge Florida in Massachusetts (Blumer and others, 1970, p. 23) killed bottom plants and animals, thereby reducing the stability of the marshland and increasing erosion. Even chronic level pollution can kill vegetation, resulting in erosion of marshes (Cowell, 1971).

Foster and others (1970) noted that the main effect of oil seeps of the Santa Barbara coast will be to reduce the availability of intertidal surfaces for the attachment and growth of marine organisms. Effects may be long term, influencing the growth and reproduction of various marine organisms, especially the surf grass and its associated flora and fauna in the intertidal zone. Examples of the loss of marine resources along the Palos Verdes and Point Loma Peninsulas over a 40-year period were noted.

The impact of introduced material on marine vegetation depends on the type of material and the time that the material is in contact with the vegetation. In an oceanic environment, dispersion and dilution set relatively short limits to contact time, processes controlled by the natural behavior of the water itself. In the coastal environment there is a wide variation in the circulation regimes of inshore waters and continuing contact with vegetation is more likely. Added considerations related to oil spills and marine vegetation are the clean-up procedures and agents used. Clean-up procedures that increase dispersion and dilution by solubilization may affect both the sea floor beyond the intertidal zone and the suspended plant plankton.

Terrestrial Vegetation

The primary impact of pipeline construction or staging area use on the islands vegetation would be destruction within all construction rights-of-way and other sites. This would be the result of clearing the vegetation, followed by possible construction of roads, camps, building foundations, berms, and pipeline excavation.

Reseeding of excavated and construction areas is quite possible, with extensive knowledge available from highway right-of-way revegetation projects. The use of mulches and seeding of grasses have forestalled the danger of erosion of fine soils. Replacement by native vegetation, some of which is endemic, is an unkown and would depend upon the characteristics of the habitat and associated plant material.

Several aspects of operation of island facilities would have an effect upon vegetation. These are maintenance disturbance, oil spills and heat and moisture. Parts of the construction rights-of-way, access roads, and staging facilities would be used through the life of the offshore oil fields; therefore, plants would not grow on them and operational and maintenance land use impacts would continue.

Terrestrial Mammals

The impact on the terrestrial mammals would be direct through habitat encroachment and secondary through potential oil spill contamination of food sources (terrestrial and beach source).

Through the beach vegetation and carrion links in the food web, it is possible that oil pollution could affect terrestrial mammals which either constantly or intermittently use the beaches. Intermittently, deer, cattle, goats, sheep and other foragers utilize beach and intertidal zone plants exclusively and would thus be vulnerable to the threat. The island fox utilizes littoral zones extensively for food gathering.

This ingestion of oil-covered carrion by, foxes, skunks, and shrews would result in petroleum hydrocarbons being assimilated directly at the top of the food chain; however, the relative toxicity of crude oil to these mammals is not known.

The impact on beach-utilizing mammals of oil hydrocarbons that have become entrained in the marine ecosystem from chronic low-level sources is unknown, but there is evidence to suggest that one possible effect is the causing of premature births in seals with a resultant death of pups.

The direct impact of construction on the smallest mammals (shrews, mice, ground squirrels, and rabbits) along the route would be of limited magnitude and of short duration. Only those individual animals having home ranges within or overlapping the acutal zone of construction would be either destroyed or displaced. This zone would be narrow enough that the initial disturbance should extend little beyond it. There would be a definite alteration of habitat within the construction zone (see section III.J.1 and 2 for estimated acreages to be impacted). Wherever vegetation cover rendered unsuitable for one small mammal species is replaced relatively quickly by cover favorable to a similar or related species, the net change from the standpoint of value to the food chain should be minimal. Wherever vegetative cover is not replaced relatively quickly by favorable cover the net change would be greater.

Any impact occurring within a construction zone should be well dissipated just outside. This is interpreted to mean that there should be little measurable indirect impact on the total system stemming from impact on small mammal species. Much the same can be said for the larger rodents and small predators. There should be little adverse direct or indirect impact on these species either.

There is potential for direct and indirect impact on both the very small mammals and the larger rodents and small predators during any pipeline operation.

There would be direct, adverse, short-term impact on small mammals anywhere that an oil spill occurred. The impact would depend on the place, the habitat, and the season of the year. It might range from minute to severe depending on the circumstance. There is insufficient information available to evaluate the long-term and indirect effects of oil spills upon small mammals.

Some mammals could die from ingesting oil from contaminated pelage while grooming (Alaska, State of, 1971, p. 63). Scavengers such as foxes and skunks, could occasionally eat oil-killed animals, thereby ingesting petroleum.

Marine Mammals

The greatest danger to marine mammals is disturbance of pinnipeds from drilling operations and from platform construction or onshore separation and storage facilities located on the islands near breeding and hauling out areas (See section III.C.3.). Six species use the Channel Islands, particularly San Miguel and San Nicholas, for this purpose (Dailey, 1974).

Pinnipeds once bred in large numbers along the Southern California mainland coast, and still do north of Point Conception in areas where little or no human activity is present. Human activity disturbs most of these marine mammals to such an extent that they will no longer breed at their established rookeries (Dailey and Carlisle, personal communication, 1974). The behavior of pinnipeds under the influence of human activity varies according to species. For example, the National Marine Fisheries Service (1974) reports the following:

> California sea lions associated with certain hauling grounds and rookeries have practically abondoned these areas because of harassment. Major populations are now located only on sites not easily reached by the public.

On the Steller Sea lion it is stated that:

> Excessive disturbance by humans of sea lions on their rookeries and hauling grounds has caused the animals to abondon these areas.

Regarding the Harbor seal:

> This animal is extremely sensitive to disturbance and may leave an area temporarily or even permanently after continual harassment by people, equipment, or aircraft.

The northern elephant seal, however, shows a high degree of indifference to humans. (Bartholomew, 1967). Northern and Guadalupe fur seals exhibit non-adaptive behavior and return year after year to the same rookery at which they were born. Conversely, sea lions abandon rookeries and select new ones when disturbed (Daugherty, 1966). Based upon this behavior, it is conceivable that only elephant seals would remain on the islands in the face of oil drilling operations with sea lions moving away and fur and harbor seals aroused to such an extent that reproduction would drop significantly or cease.

It is not known for certain if the three mile distance between the islands and drilling operations is enough to protect the pinniped rookeries from human activity. In any event, if production near the boundary did occur and caused drainage of hydrocarbons from state lands, development of those areas landward of the three mile line would be precipitated. This would greatly increase the risk of disturbance. Certainly, because of their primarily aquatic behavior, the seaward distance between rookery and human activity will have to be significantly greater than the land distance. We, therefore, conclude that drilling activities within three miles of rookeries are potentially dangerous to pinniped populations. The use of island sites close to established rookeries for onshore separation, storage facilities or related activities would very likely cause the abandonment of the rookeries. The ultimate outcome of rookery abandonment is the elimination of pinnipeds from Southern California waters. Drilling operations on tracts to the west and south of San Miguel Island, in particular, will have the potential for eliminating rookeries on this island.

The sea otter is not yet a permanent member of the Channel Island fauna, but has been expanding its range during the past several years. Bartholomew (1967) stated that "there is every reason to be optimistic that a population may again ultimately re-establish itself in the northern parts of the California Channel Islands if the habitat continues to remain relatively undisturbed and effective protection is afforded from hunters and abalone fishermen". Onshore facilities and offshore oil operations with associated increases in sport fishing boats could disturb this potential habitat enough to possibly preclude re-establishment of sea otter populations. Both sea otters and the newly established colony of Northern fur seals will experience mortality from a large oil spill which goes ashore or collects on large areas of kelp beds. Similar to what happens in birds, oil will destroy the heat insulating property of the fur, causing extensive mortality. The Guadalupe fur seal is a rare species and could also experience similar mortality if it is in the area during a spill.

Pipeline laying is not believed to be harmful to pinnipeds unless the pipeline goes ashore near a rookery or hauling out area.

Potential dangers of lesser significance include an increase in pesticides and the bacterial disease leptospirosis, both possible causitive agents of sea lion abortion, into the pinniped population from activity on oil platform or onshore facilities. Pesticides and heavy metals have been found to accumulate in the food chain of fur seals and leptospirosis can be spread from domestic animals and garbage.

Discussion of impacts on intertidal areas, and bird life of the Channel Islands are discussed under sections III.D.2 and 3 respectively.

Within the appendix of this E.I.S. is a discussion of the "Effects of Oil on Marine Ecosystems" which is an adjunct to this section on impacts on the biological communities of the coastal zone and Channel Islands.

5. Impact on Kelp Beds

The giant kelp *(Macrocystis* spp.) is apparently very resistent to damage from spilled oil because of the envelope of mucus which surrounds and protects it from damage (Anderson et al., 1969). No damage was reported to them as a result of the Santa Barbara blowout. Even in the Tampico spill, North reported only slight damage to marine flora of all species. A description of the kelp beds may be found in Section II.F.2.

The damage to the kelp bed association, especially the epifauna, caused by an oil spill is less well known. Visibility was only three inches in mainland kelp beds during the Santa Barbara blowout, so accurate determination of damage was impossible. Anderson et al. (1969) could detect no damage to the associated fauna in the oiled kelp beds of Anacapa Island. Apparently the only damage reported to organisms of the kelp bed community was a reduction of mysids (Ebling et al., 1971). Anderson, Neff, and Petrocelli (1974) reported the mysid *Mysidopsis almyra* to be the least tolerant to oil of all organisms tested. We do not know if mysids as a group are susceptible to the toxins in oil or if *M. almyra* is an isolated case within the group.

Oil was detained from reaching shore by kelp beds in the Santa Barbara blowout (Battelle, 1970) and possibly undetected damage resulted or could result to certain associates from prolonged exposure to the oil.

Dames and Moore (1973) estimated the impacts caused by laying pipelines through kelp beds by jetting, blasting, and by anchoring the lines by rip-rap.

Impacts Associated with Jetting

Large mobile organisms such as fish will simply move out of the way, but many sedentary or sluggish organisms making up the benthic community will be affected by the spoils settling to the seafloor either immediately adjacent to the trench, or down current. This will be analogous to the effects of a severe storm, with short-term redistribution of unconsolidated bottom materials. Much of the benthic community is adapted to such shifts of seafloor materials, but survival is a function of both mobility of the organism and rate and volume of cut and fill. In the immediate vicinity of the trench, mortality of the sessile or sluggish part of the benthic community will be greater than during the most severe natural catastrophic events, but the effects will diminish farther from the trench. Distribution of the spoil will depend upon the exact manner of trenching and on the wave and current conditions at the time, and cannot now be predicted. It is anticipated, however, that farther away, probably no more than a few tens of feet at the most, the rates will approximate the seasonal shifting of sediments to which many of the organisms are adapted, and with increasing distance from the trench, increasing numbers of the organisms will survive until there is no appreciable effect. Thus, the immediate impact will be significant along the pipeline route and the adjacent areas where the spoil is deposited. It is anticipated that recovery will be rapid, and by the time the displaced sediments reach equilibrium, the benthic fauna will be much as it had been.

The effects of redistributing material by trenching from the reducing zone at depths below the seafloor into an oxidizing environment on the seafloor is probably negligible. (General Oceanographics, 1971b)

Impacts Associated with Blasting

Bedrock and cobbles are exposed or present within the top three feet of sediment between the inner edge of the kelp bed and the beach. Blasting would be required to bury the pipe through this zone. Two main effects of blasting are anticipated. The first is related to the pressure (shock) wave created by the explosion. Fish and mammals within internal air spaces (e.g., lungs and air bladders) can be killed or injured by the shock wave. The range of this effect is dependent on the weight, type, and placement of the charge (Hubbs and Rechnitzer, 1952). Bottom living fish seem to have a better chance of survival than pelagic forms. The second effect is associated with the movement of substrate out of the blast site by the force of the explosion. Animals and plants in the immediate vicinity of the blast would, presumably, be killed outright. Biota further away from the explosion would be covered with debris; survival in this region would depend upon the ability of the organisms to dig their way out (in the case of motile species) or clear themselves of sediment. The blasts would also raise a cloud of sediment. The impact of this cloud would be qualitatively comparable to that of the jetting spoils.

The adverse impact of the shock wave could be mitigated to some extent by a propitious choice of explosives. Fish are evidently more affected by an instantaneous shock wave of the type produced by dynamite than by a fluctuating wave produced by slow burning explosives such as black powder (Cole, 1948). Therefore, in order to minimize the loss of fish and mammals in the blasted area, the slowest burning type of explosive available to adequately do the job should be employed.

Because blasting involves effects of both shock waves and debris redistribution, its short term adverse effects influence a wider diversity of organisms and are generally more detrimental than those of jetting. Although the population sizes of many species would be reduced near the pipelines, recovery would be rapid (within a year or two). No significant long term adverse effects are anticipated.

Impacts Associated with Rip-Rap Installation

The alternative to burying the pipeline in the inshore regions is to lay the pipe on the surface and securely anchor it in place with a cover of rip-rap (rock, concrete blocks or concrete bags). Where the pipeline and rip-rap are placed on the bottom, epifauna, such as sea stars, brittle stars, and sea urchins, may be crushed, but infauna (animals living in sediments) would be relatively little affected. If the pipe and rip-rap were laid on the surface in the kelp bed, existing kelp plants and other organisms in a very narrow zone along the route would be killed. However, rip-rap, independent of the material utilized, would soon (probably within a year) be colonized by the characteristic fauna and flora naturally inhabiting permanent substrate in the area. Recent studies indicate that fish usually concentrate around artificial underwater structures (Turner et al., 1969)

> and the rip-rap reef should be no exception. Besides providing additional habitat for game fish such as kelp bass and calico bass, the rip-rap should be especially attractive to abalone and lobsters because of the abundance of cavities.

The areal impact due to jetting would be limited to less than 40 m of bottom, while that of blasting would be only slightly larger, the exact distance being hard to predict. The time for the area to recover biologically would depend upon the time required for the destroyed sessile associates to reach sexual maturity and reproduce. Kelp require one to two years to mature. The time required for the sessile associates to reproduce will depend upon the individual species and will vary from months to several years.

Pipeline installation may stir sediments containing pollutants which may cause mortalities and/or food chain accumulation. Concerning the most polluted area, kelp beds are not reported in the parts of Santa Monica Bay receiving the most pollutants.

In summary, pipeline installation will cause short term impacts along the path of the pipeline. Biological recovery of the kelp will be about two years, while the rest of the community will take several years. Because of their mucus covering, kelp will not be harmed by a large Case 1 oil spill, but certain members of the kelp community will experience mortality. The extent of the mortality is not known, and may be extensive for certain species. The kelp bed community is not expected to be destroyed or extensively altered. As with some intertidal species, certain kelp bed species will experience retarded reproduction and/or settling activities for several months, but biological recovery should be complete in several years.

The impact of a small 500 barrel spill will be negligible. Frequent small spills, however, could cause an impact, the extent of which is unknown.

6. Chronic and Sublethal Biological Effects and Miscellaneous Impacts

The impacts from chronic and sublethal oil pollution are poorly known, hard to measure and often not considered important by the general public and others. According to Evans and Rice (1974):

> Assessments of the impact of oil pollution cannot depend solely on evaluation of immediate kills of organisms from acute exposures. Chronic lowlevel oil pollution can cause subtle changes in organisms and is potentially more dangerous to the ecosystem than dramatic catastrophic spills. For this reason the effects of chronic pollution warrant intensive study so that they will not be under estimated.

The effects of chronic or sublethal oil pollution have been touched upon in the previous sections of this statement (particularly potential food chain magnification in Section III.D.1), and only a general overview is presented here. Most of this information was taken from the recent paper by Evans and Rice (1974). Mention should be made again of the numerous variables within a geographic region and the even greater variables between geographic regions (see Section III.B.). The little information available on chronic and sublethal effects comes from various regions of the world and the effects described below may or may not be applicable in Southern California. Certainly, certain general effects are true in all geographic regions.

Carcinogenicity - some doubt remains as to the direct carcinogenicity to man from crude oil and crude oil residues in marine organisims.

A literature search and evaluation conducted for the U. S. Coast Guard by Battelle Memorial Institute (1967) noted that shellfish, although alive, may have been unfit for consumption because of the carcinogenic hydrocarbon 3, 4-benzopyrene in their bodies. Oysters that were heavily polluted and contaminated with ship fuel oil were reported to contain 3, 4-benzopyrene. The Battelle review also reported that barnacles attached to creosoted poles contained the same carcinogenic hydrocarbon (3, 4-benzopyrene). Sarcomas were elicited when extracts from the barnacles were injected into mice.

The carcinogenic benzo(a)pyrene behaves similarly to naphthalenes in the pattern of uptake, retention and release in claims (Anderson and Neff, 1974). They reported that naphathalenes accumulated in tissues in higher amounts than the other hydrocarbons, but were released more slowly.

Hyperplasia (increase in the rate of cell division) in reproductive cells of bryozoan in response to coal tar derivatives was reported by Powell, Sayce, and Tufs (1970). They noted that similar abnormalities may also have occurred in coastal faunas exposed to spills such as the Torrey Canyon and the Santa Barbara blowout. However, most observations on these spills were concerned with gross mortality and may not have detected the sublethal effects. Straughan and Lawrence (1975) investigated the reponse of a number of bryzoan species to exposure to natural oil seepage, but found no mal cell formation.

ZoBell (1971) reported the natural synthesis and metabolism of carcinogenic hydrocarbons by several marine organisms. Thus, oil pollution is certainly not the only source for carcinogenic hydrocarbon introduction into marine food webs. Suess (1972) recognized that carcinogens were in seafoods but concluded that they would probably not be dangerous unless the foods contained an excess amount of polynuclear aromatic hydrocarbon carcinogens. Carcinogenesis from oil-contaminated marine organisms has not been proved, but Ehrhardt (1972) expressed a need for carcinogenic testing of hydrocarbon fractions extracted from marine organisms contaminated by exposure to oil. Recent work by Dr. Paul Yevich, of the National Marine Water Quality Laboratory in Narragansett, R. I., has further implicated petroleum as a carcinogen. See response to the comments of the Southern California Council of Local Governments. Section IX.B.3. According to the National Academy of Sciences (1975) workshop on petroleum in the marine environment:

> Although our information is limited, the effect of oil contamination on human health appears not to be cause for alarm. From our calculation, we estimate that the carcinogen benzol(a)pyrene concentration on a dry weight basis arising from a high level of contamination by petroleum is comparable with that of common terrestrial foods. We, of course, do not recommend eating contaminated seafood, but in most cases, because of the taste factor, not many will be tempted to do so. It is clear that this is an area in which our knowledge is grossly inadequate and that the contamination of seafood by oil is clearly undersirable.
>
> "Ecological death"
>
> According to Evans and Rice (1974): indirect deaths may occur from effects at either the individual or population level. Individual organisms subjected to sublethal exposures may undergo an "ecological death" if they are less capable of adjusting to and responding to natural changes (stresses) in their physical and biological environments. For example, postmolt Tanner (snow) crab, *Chionoecetes bairdi*, lost legs during short exposures to crude oil (Karinen and Rice, in press). Even though the crabs lived through the exposure, they probably could not have survived in the natural environment because some of them lost as many as seven legs, including both chelae. Moreover, crabs or other adversely but sublethally affected organisms would be more likely to be eliminated by natural selection.
>
> Effects from chronic exposure may be adverse to a population over a period of time if exposed, but normal-appearing adults have their ability to reproduce seriously impaired. This loss may be due to physiological changes such as reduced fecundity and delayed ovary development or to impaired behavioral mechanisms which

> could prevent mate location and indentification or homing and timing of spawning. Although the effects at this level might not result in death of the adult, they could induce a trend of decreasing numbers that might eventually eliminate the population or race.

For example, Renzoni (1973) conducted a series of experiments on the toxicity of several crude oils and petroleum products to the sperm, eggs, and larvae of the oysters *Crassostrea angulata* and *C. gigas* and the mussel *Mytilus galloprovincialis*. He found a relatively high degree of tolerance by eggs and larvae but reported that the fertilizing capacity of sperm was markedly affected by similar exposures.

Other studies concerning sublethal effects on organisms which could lead to "ecological death" are by Wells (1972) who reported deaths of lobster larvae to exposures of 0.1 ml of Venezuelan crude oil per liter, while larvae exposed to 0.01 ml/liter had poor survival rates and were unable to molt to the fourth stage. Decreased limb (cirral) activity of marine larvae exposed to oil has been reported (Smith, 1968). Kuhnhold (1972), while observing toxic effects of crude oils to eggs of cod and to larvae of cod, plaice, and herring noted that the larvae exposed to oil-contaminated water were unable to avoid well-defined milky clouds of toxic oil dispersions. Blanton and Robinson (1973) observed damage to the gills of specimens of seven species of fish that had apparently been exposed to an oil spill off the Louisiana coast.

Blumer (1972) discussed how low-level chronic effects of oil may damage marine organisms because of their dependence on natural organic chemical clues for a variety of functions. Salmon and other fishes utilize organic chemical clues in migrations; predators are attracted to prey by organic compounds at the parts-per-billion level (Whittle and

Blumer, 1970); and other organisms may use chemical clues for predator avoidance, selection of habitat, and sex attraction. Blumer (1972) discussed the fears that oil pollution may interfere with these fundamental biological processes by masking or blocking, or by mimicking natural stimuli (resulting in false responses). He cited literature discussing the attraction of lobsters to kerosene and to purified hydrocarbon fractions derived from kerosene and noted that many dead lobsters were washed ashore after the West Falmouth spill. Blumer's fears about interference with chemoreception are further substantiated by the observations of Takahashi and Kittredge (1973) on crab behavior. Crabs, *Pachygrapsus crassipes*, exposed to water-soluble extracts of crude oil failed to exhibit feeding behavior or mating behavior responses when given appropriate chemical stimuli. Inhibition of chemoreception of some motile marine bacteria by a crude oil and several other hydrocarbons has been demonstrated by Walsh and Mitchell (1973).

Rice (1973) concluded from laboratory experiments that salmon fry had the capability of detecting sublethal concentrations of oil and that they might avoid areas contaminated with sublethal levels of oil, which would result in confused and nonadaptive migratory behavior.

A lot remains unknown about sublethal effects on organisms. Many of the impacts, although measurable, may be of short duration or nonexistent because of the great dilution possible in oceanic areas.

Dr. F.T. Weiss, of the Shell Development Company, supplied in written statement the following references and additions to sublethal impacts.

According to Atema and Stein,(1972, 1974) the data indicate that a suspension of 10 ppm of crude oil in water causes a doubling of the delay period between noticing food and going after it. They note that the water soluble fraction of this crude oil alone does not have a noticeable effect on the behavior and feeding times.

Weiss further indicates: in the paper of Rice (1973) no effects were found at levels of 89 ppm, 8.8 ppm and 0.75 ppm with three groups of salmon fry. In the discussion on solubility (page 4 of F. Weiss "Fate and Effects of Spilled Oils") it is pointed out that water column concentrations of hydrocarbons, even in oil-contaminated regions, are in the part per billion range.

Community Effects

Evans and Rice (1974) further pointed out: The adverse effects of oil on animal populations has been of wide concern when stocks of special interest, such as those providing the basis of a sport or commercial fishery, have been involved. It should be remembered that changes in populations of lesser apparent significance will also cause changes in the community because each species population interests with and is dependent on the rest of community. Chronic pollution may eliminate a species from an area entirely, and once eliminated that species may remain suppressed and may not repopulate the area because of continuing pollution or because its niche has been filled by a more tolerant, possibly less desirable species.

Crapp (1971) observed that fucoid algae replaced barnacle and limpet populations near an outfall where the effluent contained about 20-25 ppm oil from treated ballast water of tankers unloading at Milford Haven. Evans and Rice point out that although the relative oil content was low, the cumulative volume discharged was large (20,000 gallons of oil per year).

Platform and Pipeline Corrosion

M. Appleman (personal communication, 1974) cautioned that the potential damage to structures and pipelines by corrosive anaerobic bacteria may be shortened by organic pollution and sessile organisms. Although a full scale study has not been initiated, preliminary work indicates that microbiological corrosion of steel proceeds much more rapidly in marine waters containing high amounts of organic matter, whether from sewage or other sources, than marine waters that are relatively unpolluted.

The microorganisms involved belong to the genera *Desulfovibrio*, *Leptothrix* and probably to *Ferrobacillus*. Great numbers of large nodules occur in the steel located in marine waters having high organic pollution while smaller numbers occur in steel located in relatively non-polluted waters. The growth of the microorganisms may be preconditioned by the growth of larger benthic flora and fauna forms present on the steel.

Evidence has indicated that the redox potential is variable and lower under marine fauna such as mollusks, etc., even on structures receiving cathodic protection.

Erosion of the casing of pipelines and the steel structures of oil towers may, therefore, be inevitable. Industry spokesmen have estimated that about half of all pipeline leaks occur in lines that have been in use for 15 years or more (See Section III.A.2.).

If the protection of metals used in structures and pipelines is not indefinite, as the above preliminary results indicate, structures may have to be rebuilt and pipelines relayed periodically to prevent oil leaks of various magnitude from pipeline leaks or structure failure. The time required for metal failure through chemical and microbial erosion is not presently known, but, with present safeguards, may be around 10 years.

The dissolution of heavy metals from the legs of drilling platforms, or pipelines, involving iron with lesser amounts of nickel and molybdenum, will occur at an extremely slow rate. Any significant weakening of the structure will require years, if it does occur at all. The amount of heavy metals entering the food chain is believed to be minute at most from this process. There may be a slight concentration in some of the sessile invertebrates attached to the platforms, but the impact on, even this community, should be minor.

Terrestrial Biomes

Only a small portion of the mainland coast has natural upland biomes remaining (Bureau of Land Management, 1973, see graphic 5). Just south of the proposed lease area at Camp Pendleton remains some grassland biomes. The coastline for about 8 miles south of Mugu Lagoon has a woodland-bushland biome.

Impacts to upland biological communities caused by onshore oil facilities will be secondary. For detailed information on these impacts, see Section III.C.4. If onshore facilities are built at either of the above locations (we assume the Camp Pendleton area will be free from construction) the only natural coastal areas remaining in Southern California will be subjected to these impacts.

7. Endangered or Threatened Wildlife

The impacts on endangered or threatened wildlife would arise from the same sources previously discussed, however, because of the precarious nature of their populations, these species would tend to be more severely affected. Table III-25 lists the estimated population numbers of endangered and threatened species and indicates the approximate percentages of the world and United States populations which may be found in the proposed sale area.

Cetaceans compose a majority of the endangered species which could be affected. As previously mentioned there have been no extensive experimental studies conducted on the effects of various petroleum products on most of these species. A description of this may be found in Section II.F.6.

The only endangered species which received detailed study during the Santa Barbara oil blowout was the California gray whale, which was apparently unaffected although they were involved in their annual northern migration during the incident. According to the California Dept. of Fish and Game (1969), there was some concern about the California gray whales, *Eschrichtius gibbosus*, that were passing through the area on their northern migration. On February 3, 1969, a young gray whale was observed from the air floating near the surface in an area with considerable oil and straw on the water. At first glance, the whale appeared dead; however, when the plane made a second pass to get pictures, the animal dove and swam away. Other whales were observed in the oil leak area during the first half of February, but none showed any signs of being in distress. There were five whales (three were California gray whales) that did wash ashore in February and March at various points along the California coast. On March 14, 1969, the Department conducted an aerial survey of the coast from Ventura to Monterey, but failed to find any more dead whales floating at sea or washed up on the beach. An autopsy performed on one of the whales that washed ashore failed to determine cause of death, but there was no sign of oil in any of the whale's vital organs. Historically, two or three dead California gray whales wash ashore along the California coast during the late winter and early spring months. During some years there have been as many as five.

Of the other threatened species, birds which occupy the bays are in the greatest danger from an oil spill. The most critical bays are Mugu Lagoon and Anaheim Bay because of their size, relative unaltered condition, and proximity to the proposed lease areas. Due to its wide entrance to the ocean at high tide, Mugu Lagoon would be highly vulnerable to the possibility of being contaminated by oil from a noncontained spill. The birds involved are the light-footed clapper rail, California least tern, and Belding's savannah sparrow (see Graphic 3 for nesting site distributions). If large quantities of oil from an oil spill were to invade a wetland habitat occupied by any of these birds, death to individuals could result from loss of insulative value of oil soaked feathers, injestion of oil coated food, or loss of nesting sites. Since these species are rare in the first place, the complete elimination of them in a given oiled bay is possible. The possibility of repopulating a destroyed area from another bay, will depend upon the number of bays severely oiled and the number of additional bays occupied by a given species. No spill will be massive enough to severely oil every estuary south of Point Conception. It is more realistic to assume that only a couple of wetlands would be severely oiled. The increased numbers, migration habit, and wide distribution of the least tern (Bender, 1973) should provide a sufficient population stock to enable reinhabitating affected areas after oil has been cleared. The principal breeding season is the spring of the year, so reoccupation will not begin until the following spring or even a year or two later. Reproduction would probably begin the year following reoccupation.

The more scattered distribution of the California clapper rail and possibly Belding's savannah sparrow (Graphic 3) may prevent these species from natural reoccupancy. The proposed lease tracts off Anaheim Bay and possibly upper Newport Bay (the probability of oil reaching upper Newport Bay is very low) are the most critical to clapper rails. They are not migrators and spend their lives in a restricted area. Therefore it is highly unlikely the clapper rail will withstand a major oil spill reaching their habitat.

The brown pelican nests only on Anacapa Island (Section II.F.6) but feeds on ocean fish. There is a possibility that hydrocarbons may build up in the food chain and become accumulated in tissues similar to DDT. The effect of chronic hydrocarbon buildup in tissues of pelicans is not known. The effect of human disturbance on the nesting areas of pelicans is not known. However, it is highly unlikely that oil companies will be given permission to construct shore facilities on Anacapa Island (the brown pelican's only nesting site) which is a National Monument.

The impact on the California condor, island fox, and other terrestrial animals will be secondary involving alteration of habitat and increased human activity. The species most likely to be affected by this is the island fox if facilities are built on the Channel Islands. The extent of this impact on the island fox would vary with the type and location of facilities and could range from temporary relocation to avoid human activity to complete extermination through loss of suitable habitat and denning sites.

The Island Fox could also be affected more directly by OCS development through ingestion of oil covered food in the intertidal zone where it gathers much of its food during summer when dry weather restricts the upland food supply.

Although some animal species (possibly including some rare or endangered species) are highly vulnerable to petroleum and could be wiped out by a major oil spill, many species seem to reassert themselves following the initial die-off after a spill (California Coastal Zone Conservation Commission, 1975).

Another unknown, which applies to all threatened species, is their ability to reinhabit an area once it has been disturbed by humans, whether this disturbance be an oil spill or alteration of habitat. One of the criteria established by the California Department of Fish and Game (1973) for an endangered species is that its prospects of survival and reproduction are in immediate jeopardy from loss of or change in habitat.

TABLE III-25

Estimated Populations of Rare or Endangered Species 1/

Endangered 2/ Species	World Population	U.S Population	Calif. Population	% World Population	% U.S. Population
BIRDS:			1,000		
Calif. brown pelican	100,000 +	20,000	1,500	1-1.5%	5-8%
So. bald eagle	1,200 +	800-1,200	62	5%	5-8%
California condor	50	50	50	100%	100%
Light-footed clapper rail	1,000	500±	500±	50%+	100%
Calif. least tern	2760 +	2760+	1,380+	50%+	50%+
Belding's savannah sparrow	2118	2118	2118	100%	100%
American peregrine falcon	700 +	46±	4±	0.5%	9%
MAMMALS:					
Cetaceans:		(No. Pacific)			
Right whale	4,500	250	250	5%	100%
Gray whale	11,000	11,000 33,000-	11,000 33,000	100%	100%
Sei whale	115,000	37,000	37,000	29-32%	100%
Blue whale	8,600	1,500	1,500	17%	100%
Finback whale	97,000 - 100,000	10,000- 13,000	10,000- 13,000	10-13%	100%
Humpback whale	5,200	1,200	1,200	23%	100%
Sperm whale	699,000	254,000	254,000	36%	100%
FISH:					
Unarmored three spined stickleback	No data (N.D.)	N.D.	N.D.	100%	100%

TABLE III- 25
Estimated Populations of Rare or Endangered Species[1]

Rare Species[3]	World Population	U.S. Population	Cal. Population	% World Population	% U.S. Populatlion
BIRDS:					
California black rail	N.D.	N.D.	N.D.	N.D.	100%
MAMMALS:					
Island fox	N.D.	N.D.	N.D.	100%	100%
Guadalupe fur seal	600	< 10	< 10	< 2%	100%

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[1] All population figures are rough estimates based on current literature and personal communications.

[2] Species listed on the U.S. Fish and Wildlife Service list of endangered fauna, 1974.

[3] Species listed as rare by the California Department of Fish and Game, 1974.

E. Impact on Commercial Fisheries

Offshore oil and gas operations interfere with commercial fisheries in three general ways: 1) removal of sea floor and pelagic areas from use; 2) creation of obstructions on the sea floor that damage trawling nets; and 3) loss of catch due to presence of oil in water and/or flesh. Note that since fish populations congregate around platforms (potential pollution sources), the potential for contamination is increased. A description of Commercial Fisheries operations in Southern California is in Section II.G.5.

1. Removal of Sea Floor and Pelagic Areas From Use

Bottom trawl fishing is not important on the Southern California Borderland south of Point Dume. The California halibut trawling grounds, established by the Department of Fish and Game, extends from Point Arguello southward to Point Mugu. Trawling is permitted beyond one mile from shore to a depth of 25 fathoms. Only between Santa Barbara and the Hueneme Canyon does this depth limit of 25 fathoms extend to or past the 3 mile limit. Therefore, there will be no interference with trawling on the designated halibut trawling grounds as a result of this proposed sale. However, it should be noted that a potential for a trawl fishery exists in all the lease areas. All sites occupied by drilling or production platforms and attendant service boats and barges must be avoided by trawlers. If the exploratory structures are jack-up drilling rigs or permanent production platforms, the area of the sea floor eliminated from commercial fishing would amount to 2 to 5 acres for each structure. In deeper waters (over 300 feet), a semi-submersible drilling rig with its anchoring system would occupy up to 325 acres (assuming a 1500 foot anchoring radius). Based on our Gulf of Mexico experience, the duration of exploratory drilling ranges from under 45 days for a single well to around six months for multiple well explorations. Permanent production platforms may remain in place for 10 to over 20 years.

Purse seining is the largest commercial fishery in the lease area. Purse seine fishermen are at drift and almost completely at the mercy of winds and currents while the net is in the water, a period of 2 to 4 hours. Seines used by tuna fishermen are commonly 600 fathoms long and 60 fathoms deep. Mackerel seiners use smaller nets, commonly 265 fathoms by 30 fathoms. Winds of 10 to 15 knots are common and the fishing boats, even with their seines deployed, can drift up to 15 miles (local fishing organizations in cooperation with personnel of the National Marine Fisheries service and California Department of Fish & Game).

Special configuration of the production platforms will be important to fishing operations. Clusters of platforms in small areas will be less detrimental to fishery operations than platforms equally spaced one every tract or two over larger distances. Heaviest fishing occurs on the San Pedro shelf, Cortes-Tanner Banks and other relatively shallow areas, where oil discovery is most probable. Unburied pipelines, large materials or tools accidentally dropped overboard in water depths of less than 250 to 300 feet could easily snag and destroy purse seine nets. Materials remaining on the sea floor at the site of abandoned and disassembled platforms at similar depths could also present snag problems (Fishermans Cooperative Organization, personal communication, 1974).

According to O. Allen (personal communication, 1974) menhaden fishermen in the Gulf of Mexico do not complain about oil platforms interfering with their purse seining operations. This would indicate there is no problem involved, particularly when considering the numerous complaints received concerning trawl fishing and oil operations in the Gulf. However, to more completely analyze the situation, it should be remembered that the accelleration of Gulf Coast commercial fisheries and oil operations began at the same time, just after World War II. Oil structures may simply be tolerated by fishermen even though total fishing area available to fishermen has been somewhat reduced according to R.Chapaton (personal communication, 1974). Gulf menhaden are shallow water species with the majority occurring within one mile of shore. Approximately 90% occur within three miles offshore. On the other hand, the Southern California wetfish and tuna fishery is important in areas further removed from the coast (Section II.G.5.).

Total number of platforms required to develop a lease area and their spacing relative to each other are important factors in considering potential impact on commercial fishing activities. Because it is imposible to determine these factors in advance of proposed sale, a special stipulation (see Section IV., Mitigating Measures) has been suggested. It is felt that if careful planning and coordination are not undertaken, an additional impact will result.

2. Creation of Obstructions on the Sea Floor That Cause Damage to Trawling Nets

The obstructions referred to here are underwater stubs, large pieces of debris, and unburied pipelines.

The source and nature of stubs is described in Appendix 9. As already stated, Coast Guard Commandant Instruction 3264.2 requires that stubs or underwater completions be marked by a buoy at the surface, as required by the District Commander, if located in less that 85 feet of water. However, the Coast Guard has informed us that in spite of regular maintenance and replacement, these buoys are frequently found to be missing. If a trawler tows his net across a stub, the net would certainly be badly damaged or lost.

Large pieces of debris, such as equipment, piping, structural members, tools, and the like, may accidentally be lost off a platform or service barge. Losses off a platform may be located easily by divers and retrieved. However, if it is lost off a boat or barge underway, the location may not be known accurately enough to allow its subsequent recovery. Depending on the size and weight of items lost in this way, varying amounts of damage may be done to trawling nets of fishermen unlucky enough to snag them. Pipeline corridors will be established, wherever possible, in the area of this sale (Section IV.D.2). Pipeline burial within the corridors may be required to a depth of three feet in water depths of 250 feet or greater. (See Section IV.D.2.).

3. Loss of Catch Due to Oil Contamination

Attempts to quantify fisheries losses from a hypothetical oil spill can be extremely misleading because the great number of variables involved can produce drastically different results under varying circumstances. Nevertheless, to provide a very rough idea of the possible consequence of a spill, we will assume a blowout produced spill of 100,000 bbls. over 61 days. The result could be a 500 square mile oil slick, which if superimposed on the Bight's most productive fishing blocks might result in a 3,750,000 pound reduction in fish catch. (The median number of pounds/block for 1970-71-72 was used. Note that the variability is very large from year to year.) This presumes that no fish are taken for 60 days and that half the median number are captured during the next 60 days. It should be pointed out that if fishing efforts were concentrated elsewhere, outside the contaminated area, that fish landings might not decrease at all. A figure of $184,600 representing the loss to fishermen as a result of a spill was based on the assumption that the catch in the affected area consisted of mackerels, anchovies and sardines. The relative importance of each species is based on the number of pounds of each species landed at San Pedro during 1972 (Oliphant personal files, 1974). Value is assumed to be $115 per ton for mackerel and $35 a ton for anchovies and sardines. (There is a moratorium on sardines and they are only caught incidentally.) The figure of $184,600 is an extremely conservative estimate because 1) some of the mackerel will be sold as live fish and not reduced or canned, thus averaging a much higher price, and 2) many fish, more valuable than anchovies, mackerels and sardines, will in fact be landed. Long term deleterious effects could also result. There are three particularly important ones, impossible to quantify. 1) If large amounts of plankton were destroyed the food web could be seriously disrupted and result in population crashes or organisms directly or indirectly dependent upon the plankton. 2) Entire year classes of juvenile or larval fish might be destroyed resulting in greatly reduced yields several years after the spill. Ketchum (1973) refers to Mironov's work in 1967, stating there was 100% mortality in developing flounder spawn at concentration, ranging from 1-100 ppm in three types of oils. 3) Oil pollution might lower organisms' resistance to disease and other environmental stresses. This could produce less robust, lighter weight individuals and an increased mortality rate over a long period of time, causing a slow, but marked decline in fisheries. Ketchum (1973) showed that abnormal development occurs following longer periods of exposure to concentrations as low as .01 ppm. 4) Fish may have to be discarded due to tainting of the flesh. One example was given by Connel (1971) who stated that the Australian mullet had a kerosene-like tainting due to the presence of kerosene-like hydrocarbons in the flesh. He found the contaminated compounds to be similar to substances isolated from river sediments. The river used by the mullet flows alongside oil refineries and associated storage and wharf facilities. Volatile hydrocarbons were found in the water adjacent to petroleum storage facilities and also in the river's estuary near a sewage fallout. In addition, R. C. Clark cited the work of Shipton et al. (1970) and Vale et al. (1970) concerning the same subject--kerosene-like tainted Australian mullets. Shipton, through gas chromatography and spectral analysis reported the isolated kerosene appeared to be similar to a commercial sample of kerosene. Liver examination by optical and electron microscopes revealed higher amounts of free fat than in untainted samples (Vale, 1970). This condition in "higher" animals can be caused by petroleum distillates (British term "benzene", Browning, 1953). Sea-trout and plaice were found to be tainted according to taste test. These fish were caught after the Torrey Canyon incident involving the spillage of Kuwait crude oil. No chemical analysis by chemical class was reported (R. C. Clark, 1973). If the spill were to occur in shallow, pristine areas, such as Cortes-Tanner Banks, long term fisheries losses would almost certainly be incurred. Heavy wave action is frequent on these banks and the waves could mix oil down through the water column and over the reefs, killing and injuring large numbers of invertebrates and algae. Areas like the Cortes-Tanner Banks, nearly free from pollution and experiencing very little change in environmental conditions, are particularly vulnerable because stable conditions often result in organisms being unable to cope well with environmental changes. Members of the same species/sub species, living along the mainland coast, are regularly exposed to larger fluctuations in the form of pollution, fresh water run off and so on. Therefore, small quantities of oil which might be tolerated by mainland coast organisms might destroy the same species in an area like Cortes-Tanner Banks.

Numerous studies on the effects of oil on commercially important shellfish indicate that these invertebrates may both absorb, and to varying extents, clean themselves of hydrocarbons.

Oysters, *Crassostrea virginica*, may accumulate oil through feeding activity in a pollution zone. As the oyster feeds, it pumps water over a series of gill filaments which trap food particles such as phytoplankton. Hydrocarbons in the plankton may be incorporated in the oyster. Erdhart (1972) has found that oysters taken near the entrance to the Houston Ship Channel in Galveston Bay, Texas are contaminated with a high content of petroleum derived hydrocarbons. Because aromatic hydrocarbons are more soluble than paraffinic and napthenic hydrocarbons, the oysters most likely take up the aromatic fraction as a water solution through their gills, and as filter feeders by accumulation of particulate food matter. The author found the composition of oyster contaminants to be similar to many Texas crude oils, among them Conroe crude, Beaver Lodge crude and Lee Harrison crude.

Results from Blumer's (1972) study on more highly aromatic #2 fuel oil suggest that oil becomes part of the organism's lipid (fatty) pool. Blumer noted that the oil in specimens observed from a Massachusetts oil spill remained relatively unchanged in composition or quantity. He reasoned that if the oil were localized within the digestive tract, a shellfish could eliminate it rapidly. But the persistence of the hydrocarbon over a time period of six months, its presence in adductor muscle tissue and the lack of further degradation of these hydrocarbons indicated that it becomes part of the organism's lipid pool.

Anderson (1973) observed oysters, *Crassostrea virginica*, and clams, *Rangia cuneata*, exposed to South Louisiana crude oil and to #2 fuel oil, and came to a different conclusion. Anderson found that both aromatic and saturated hydrocarbons are released from the tissues more rapidly; maintenance in clean water for periods of 24 to 52 days was reported sufficient to cleanse the tissues of detectable levels of hydrocarbons.

Teal and Stegeman (1973) measured the amount of hydrocarbons remaining in contaminated oysters after their return to clean water and found that a concentration of 34 mg/g wet wt. persisted in a "stable" compartment. The authors concluded that, while the oysters would not retain non-biogenic (petroleum) hydrocarbons permanently, complete removal would take a "considerable amount of time."

St. Amant (1973) reported that under field conditions, oily tastes generally occur in oysters when the substrate exceeds 500 ppm of hydrocarbon. He said that if the oysters are removed to unpolluted areas and allowed several months of depuration[1], they will eventually purge themselves of oil to a point where noxious tastes are not detectable.

Scarrot (1971) has found that commercial species of scallops ingested spilled Bunker C oil. Subsequent chemical analysis revealed the presence of Bunker C in the mantle, digestive gland, adductor mussel, and gonad.

Evidence is increasing which suggests that marine organisms have the ability to depurate accumulated petroleum hydrocarbons. This suggests that the classical food chain buildup does not occur with petroleum hydrocarbons. The fact that the animals tested do accumulate hydrocarbons in rather large quantities indicates that temporary food chain buildup can occur. The naphthalenes remain within the prey species the longest and are also among the most toxic petroleum fractions (Anderson et al., 1974). The carcinogen benzo-a-pyrene acts similarly to naphthalenes in animal tissues. If the temporary accumulation of naphthalenes and/or benzo-a-pyrene reached high enough concentrations in predators, death or possibly cancer could result. The impacts would be of far shorter duration and have a lesser total impact on the marine ecosystem than if the classical food chain buildup did occur.

According to a summary paper by Anderson, Clark, and Stegeman (1974) accumulated petroleum hydrocarbons are rapidly transferred to gall bladder, brain and other neural tissues, and liver of fish or the digestive gland of shrimp. Damage to fish having concentrations of petroleum hydrocarbons in the nervous system can be speculated as being detrimental, particularly by increasing nonadaptive behavior responses. The danger to the human consumer, however, would be lessened considerably, as liver, gall bladder and much of the nervous system is discarded prior to consumption. The danger to humans who consume contaminated oysters, which are eaten in their entirety, would be significantly increased. As indicated in Section II.G.5.f., oysters are not an important food in the sale area.

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[1] Depuration: The process whereby a contaminated shellfish partially eliminates hydrocarbons from its system through continued exposure to clean water.

Studies on the effects of petroleum hydrocarbons on shrimp are few. St. Amant (1973) referred to a concentration of oil of 10 ppt as being lethal to these organisms. He added, however, that to reach this concentration under field conditions, more than 3,000 gallons of oil per acre foot of water would be required to meet the concentration. This concentration is rarely acquired except in the immediate area of a spill.

Effects on shellfisheries of the Southern California Borderland due to oil operations have apparently been less well studied. Similar effects are expected to occur with local filter feeders as reported above.

In summary, we caution against both short and long term deleterious effects on commercial fisheries. Oil spills may physically prevent fishing in contaminated areas for months. Adult fin fish are not normally killed outright, but may suffer a long term decline due to lowered resistance to disease and environmental stress. Larval and juvenile fish can be killed in great numbers. Many fish not destroyed may be tainted with hydrocarbons and be unmarketable. Shellfish are more susceptible to contamination because of their inability to escape and their general filter feeding habits. Many larval and juveniles could be killed outright. Survivors could be tainted and unmarketable for long periods. Authors disagree on the time required for shellfish to cleanse themselves. Estimates vary from several months for complete depuration to six months with no depuration. In addition to fishing losses from oil spills, additional losses will result from the elimination of trawling and purse seining areas due to the physical presence of oil exploration/production structures.

F. Impact on Air and Water Quality

1. Impact on Air Quality

The quality of air over the proposed sale area can be degraded from several types of sources including exhaust emissions from stationary power units, source vehicles, and by the accidental release and combustion of oil or gas. Because of the distance of most of the lease areas from shore, the impact of exhaust emissions from offshore facilities would probably be small and unimportant. However due to the prevailing metereological conditions, emissions from operating facitities in the nearshore tracts of San Pedro Bay, and Santa Monica Bay could add to the air quality degradation onshore.

An oil spill from a platform would result in air pollution by the loss of the lighter fractions through evaporation. Approximately one-third of the initial volume of spilled oil, or those fractions which boil below 300 degrees C, may evaporate or sublime to the atmosphere thus deteriorating the air quality. A major oil spill would release many pounds of hydrocarbons into the air, or from fifty to one hundred pounds per barrel of oil. As an example, Nelson-Smith (1970) stated that the hydrocarbons (HC) evaporated into the atmosphere from the Torrey Canyon Spill off Southern England were approximately equal in quantity to the total amounts of sulfur dioxide and smoke in the atmosphere over Great Britain.

Assuming a 100,000 bbl spill, and 50 pounds of HC evaporated per bbl, and a reactive fraction of 15% (based on information by the Air Pollution Control District), the mass burden of reactive hydrocarbons (RHC) released into the atmosphere is:

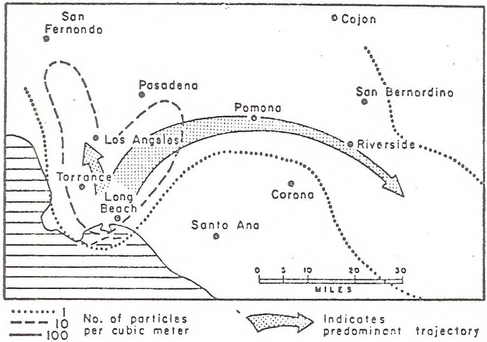
$$100{,}000 \text{ bbl.} \times \frac{50 \text{ lbs.}}{\text{bbl.}} \times \frac{1 \text{ ton}}{2000 \text{ lbs.}} \times .15 = 375 \text{ tons of RHC}$$

The 375 tons of RHC would be totally volatilized within one day of a spill, and would blow into the air basin. The transport time, of course, would depend on the distance of the spill from shore. The further the spill from shore, the more dispersion of the pollutant before it entered the air basin. Conversely, a spill immediately offshore would have less transport time and would cause more of a negative impact in the air basin. The length of time the RHC would linger over the air basin depends on the weather factors onshore. On a hot summer or fall day with wind speeds less than normal and with a low inversion system present, the longer the RHC would remain. Under those conditions, the pollutant would disperse within twenty four hours. On a winter day with opposite conditions, the RHC would be dispersed and pass over the air basin in transit.

The above spill case assumes a major spill of 100,000 bbl occurring at once. In reality, the spill would occur over a longer period of time thus introducing a steady input of RHC into the air. On the basis of the Santa Barbara spill of 1969, the spill occurred over a ten day period. Assuming that the high case of 100,000 bbl. spill was to occur over a ten day period or 10,000 bbl. per day, the resultant amount of RHC introduced into the air would be 37.5 tons daily. The amount would increase the daily amount of RHC in the Los Angeles Air Basin by approximately five percent, and the amount in the South Coast Air Basin by about three percent each day for the ten day period.

This increment is approximately equal to half of the total of the 770 tons of RHC now being released daily in the entire Los Angeles air basin. Over 1,100 tons are released daily in the South Coast Air Basin which includes all of Ventura and Orange Counties, and portions of Santa Barbara, Los Angeles, San Bernardino, and Riverside Counties. Most of the volatilized materials, under normal atmospheric conditions, would be swept onshore to form an enlarged, but not a dispersed plume traversing the air basin. A typical type trajectory would transport the plume north and slightly west into the eastern San Fernando Valley, or north and then eastward toward Pomona and beyond. For example, a study conducted by Metronics, Inc. using fluorscent tracers showed that pollutants from a fossil fuel power plant in Long Beach can be transported inland over distances of 60 miles or more within a single day. See accompanying figure. By any measure, emissions of RHC of this order of magnitude could have serious downwind consequences on oxidant levels depending on wind patterns, meteorological conditions (which also affect evaporation rates), and the actual location of the spill.

An oil well blowout which results in a fire would normally contribute a considerable amount of pollutants into the air over the lease area, but because of the distances involved from the land, and the wind patterns, the onshore impact will be negligible. The lease areas offshore Los Angeles and Orange Counties are of such distance from the shoreline, three plus miles, that air deterioration would occur over the land. The Air Pollution Control District for Los Angeles County and Orange County concur that particulate matter would be introduced into their respective air spaces and would cause a nuisance factor through soiling. If a prolonged fire were to occur, the onshore impact would be noticeable because the four percent air pollution carry over from one day to the next would be increased by the introduction from the offshore source. The four percent air pollution carry over mentioned by the Los Angeles APCD in December, 1974, has since been questioned and is being reevaluated.



Tracer test summary, August 3-4, 1973, Long Beach source--elevated to simulate industrial pollutants. Contours represent an effective average concentration of tracer material from a normalized source of 5 X 10^{14} particles, released 0900-1500 hours, PST, on August 3 from a power plant stack. (Metronics Associates, Inc., Technical Report No. 197, July 1974.[3])

The impact on the offshore islands would not be great because of the moisture content of the air, the wind patterns and air speed, and the relative location of the lease areas to the individual islands. However, in some cases the presence of moisture in the air promotes the formation of nitrous acid and sulfuric acid. A reasonable estimate of the range of emissions to the air, assuming complete combustion for each one thousand barrels burned, according to Levorsen (1958) could result in:

CO_2 : 340,000 to 347,000 pounds
SO_2 : 620 to 34,000 pounds
NO : 660 to 10,000 pounds

Values used in the calculation are based on world averages for crude oil of 310 lb/bbl. percent content by weight is: Carbon 82.2 to 87.1; Sulfur 0.1 to 5.5 and Nitrogen 0.1 to 1.5.

Combustion of oil would actually be incomplete, and emissions would contain somewhat less of the above compounds. Other materials could also be present including volatilized particulate, carbon monoxide, nitrous oxide, sulfur monoxide, together with other altered or partially oxidized matter. There is no reliable way to predict in advance the relative volumes of each of these possible emissions because it would depend upon such factors as moisture content of the air, wind speed, pattern of oil spray from oil wells, number of wells involved, chemical content and physical character of the oil itself, and the types of equipment and materials other than oil which might also burn. In the case of an accidental release or the burning of natural gas, the onshore impact would be negligible. According to Ley (1935) the average composition of natural gas is:

Methane	CH_4	72.3%
Ethane	C_2H_6	14.4%
Carbon Dioxide	CO_2	0.5
Nitrogen	N_2	12.8

If the well was not burning the gases would be released into the air, and would contaminate the air since it has a 7-10% RHC factor.
If the gas well was burning, combustion would essentially be complete and the emissions would consist almost entirely of carbon dioxide (CO_2) and

water. The nitrogen would remain as N_2 at lower temperatures, but at higher temperatures a varying percentage of NO_x would be produced. Any sulfurous gases would be oxidized to SO_2.

A platform blowout or spill of oil or gas would result in varying degrees of deterioration of air quality within the lease area, but there would be an onshore impact as mentioned above.

During the installation of onshore pipelines and facilities, dust and fumes would be coincident with construction activities. The impact would be only during the time of construction and would end at completion of the activity.

A large gas pipeline leak would be detected by pressure or flow sensing devices, and would lead to automatic pipeline shutdown; however, small gas leaks would require a greater amount of time to detect. The major hazards posed by a gas line leak generally are fire and the toxicity of hydrogen sulfide in the gas stream. Because of distances from human activities and the dispersive effect of normal air current offshore, a small leak would present little danger.

Dust and fumes resulting from onshore treating and storage facilities would occur only during the construction period and would be confined mainly to the activity site since watering fill areas and access roads would mitigate the impact of dust. Natural air currents would aid in the dispersal of fumes and exhaust vapors.

With offshore drilling and treating facilities, the heating, treating, and water cleaning equipment on a vessel would provide for the prevention of gas vapor emissions. Boiling of oil from the heater treaters would serve to minimize vapor losses and emissions in the storage tanks.

Any vapors which did evolve in the crude storage, water tanks, or flotation unit would be collected and piped to the vessel's incineration system. Some vapors would be released to the atmosphere during loading operations, but the distance from shore and the normal ocean breezes would dissipate the vapors and prevent any adverse onshore air pollution impacts.

The presence of sulfur in natural gas presents a possible environmental problem by introducing pollutants into the air. Any activities which would deteriorate the air quality would be located at the platform, the treatment plant, or onshore by consumer use.

During operations at the platform connected with development and testing phases, the flaring procedures would release SO_2 into the air and possibly H_2SO_4 when the atmospheric moisture is at high levels. The moisture level normally is high in the marine environment. Because of the distance of the platforms from shore, no onland adverse impact will occur.

During the platform activities gas may either be reinjected into the reservoir or be treated before sale to reduce the sulfur content.

Any onshore operations relating to natural gas would be subject to regulations of the Air Pollution Control District in terms of atmospheric emissions. The Air Pollution Control District monitors such functions for compliance and has the authority to shut down operations failing to meet certain standards. Possible gas polluting operations at the treatment plant would include general low level leakage, tail gas disposal, and emergency use of the flare stack which would release SO_2 into the air. No adverse impact will occur during normal operation procedures.

In the event that a petroleum refinery is constructed during the life of the proposed project due to increased demand, emissions of nitrogen oxides, olefins (or reactive hydrocarbons), hydrogen sulfide and particulate matter would be produced. Although these emissions can be reduced, at present there is no known technological improvement that will eliminate them (Corps of Engineers, 1973). Catalytic cracking refineries produce more olefins than do hydrocracking refineries. Olefin emissions are reduced by the use of a CO boiler between the cracker and the exhaust stack. The following table presents the average contaminant emissions per day for refineries (15) in the Los Angeles basin (see Section II.G.1.). For a rough estimate, average emissions per day for a typical refinery in the area would be roughly 8.5 tons per day. However, it should be noted that this figure would probably be lower for any new refinery since emission standards and stricter existing regulations must be complied with.

South Coast Air Basin
average emissions of contaminates into the
atmosphere of Los Angeles County, 1970
(South Coast Air Basin Portion)
(Tons Per Day)

Emission Source	Organic Gases Reactivity			Particulate Matter	Oxides of Nitrogen	Sulfur Dioxide	Carbon Monoxide
	High	Low	Total				
Stationary sources							
Petroleum Refineries	5.0	40.0	45.0	5.0	22.0	50.0	5.0

Source: Air Quality and Air Resources Management of California's Coastal Zone, Appendix VI, Air Resources Board, 1971

Low level pollution may result from consumer usage of natural gas if residual sulfur was present. The burning would add to the SO_2 level of the air, but it is not possible at this time to determine the magnitude, range, or geographical regions that would be affected.

The accompanying map indicates the onshore air basins of Southern California where air pollution presently exists. See Section II.H.1. for present levels of pollution. The solid line indicates the legislative air basins as organized by the State of California Air Resource Board in 1968. The air basins were composed of areas having similar meteorological and geographical conditions with consideration given to the existing political boundaries wherever practicable. (Figure III-19).

The dashed line outlines the geographical or natural air basins which are related to the existing geographical features. The natural basins closely approximate the areas of existing urban development and urban expansion. These basins, because of their location and shape, are vulnerable to any air pollution that is generated by normal everyday onshore activities found throughout Southern California. The dots indicate the location of the stationary monitoring units operated by the local Air Pollution Control Districts.

In summary, day-to-day operations both onshore and offshore will have resultant impacts on the air quality. The offshore activities will have a lesser impact than those onshore in that the activities will be fairly well dispersed in a large area swept by ocean breezes. A large case spill or fire, however, would result in a significant negative impact onshore.

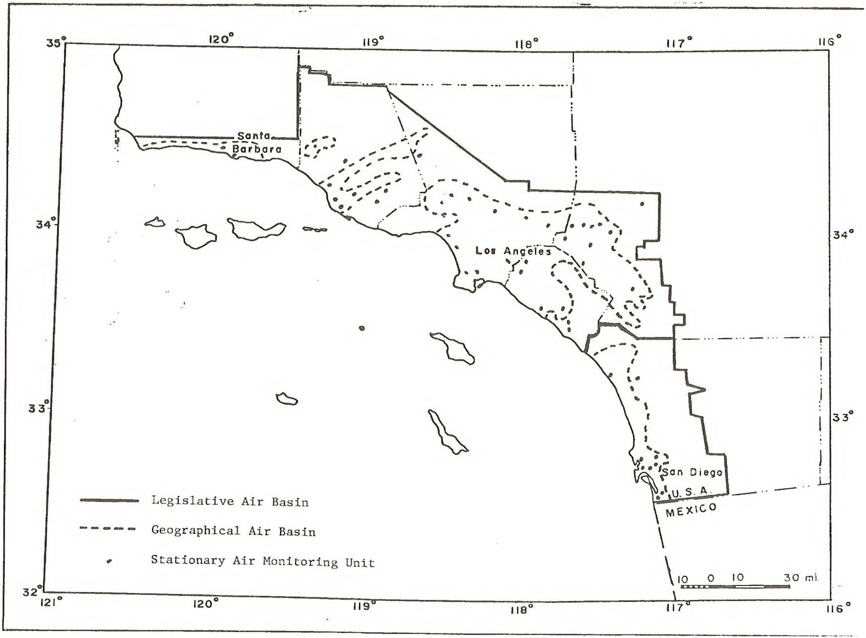


Figure III-19 Southern California Air Basins.

The onshore operations will contribute to lowering the air quality through stationary and nonstationary sources. Other refineries and related uses in the Los Angeles area do not significantly violate the air quality standards established by state and local governments. The presence of new facilities will employ the most up-to-date techniques which will be more efficient than the older existing facilities thereby lowering the amounts of undesirable emissions for any future facilities.

The air pollution resulting from the proposed project also would have a negative impact on the agriculture in the area. The amount of the impact varies depending on the time of year, the geographical area impacted and the duration of the adverse condition. Generally the pollutants causes collapse of the leaf tissue and bleaches or glazes leafy plants. The simplest olefinic hydrocarbon, ethylene, affects field crops and flowering plants such as orchids. Secondary pollutants such as ozone, peroxyacetylnitrate (PAN) and NO_2 adversely affect plants such as lettuce, citrus trees, and ponderosa pines. Refer also to the response to the Bureau of Outdoor Recreation in Section IX.B.1.n.

The direct effects of pollution on human life are well known and documented in medical records. Generally, the respiratory systems of the human body become affected causing tissue damage. Persons having respiratory ailments have their conditions aggravated by the presence of contaminants in the air. The deterioration of air quality caused by the proposal would have a potentially negative impact on human health.

2. Impact on Water Quality

During drilling and oil production the water quality of the ocean may be altered and degraded in several ways. Many of the chemical and physical factors which will be transferred to the ocean during various phases of oil production will represent potential hazardous water quality parameters. These potential hazards of degraded water quality may be found to be insignificant or possibly catastrophically disastrous. The magnitude of many potential hazards should be answered by future research.

Debris and bilge pollution materials may be released into the California OCS waters from seismic vessels, research vessels, crew boats, tugs, and service and supply boats used throughout the various operations. The quantities involved should be similar to amounts released from all types of vessels nation wide.

Sewage will be treated in accordance with OCS Order No. 8, which requires the treated effluent contain less than 50 ppm of biochemical oxygen demand (BOD), less than 150 ppm of suspended solids and a minimum of 1.0 ppm of residual chlorine after a retention time of fifteen minutes. Treated sewage of this type, which has proper discharge diffusion, should produce a minimum amount of water quality deterioration except in the immediate area of sewage discharge.

To some degree, bottom sediments would be put into suspension by the emplacement of re-entry collars, blowout preventers, drilling platforms and other sea-bottom equipment. The magnitude and extent of resultant turbidity would be dependent on the type and grain size of bottom materials, the prevailing water current and the duration of the activity. Proposed lease areas should have a short term impact from resultant temporarily increased turbidity. Areas in which drilling will resuspend polluted materials (areas in which sanitary, industrial and ocean dumping disposal material has accumulated) could have a significant impact on the marine aquatic environment producing a potentially irreversible effect on organisms exposed to the pollutants. An impact would thus result in any areas in which drilling would release toxic chemicals, biostimulatory agents, or oxidizable matter into the water column. The magnitude of the impact will depend on the type of material resuspended and its concentration.

Water quality degradation is also effected by resuspension of sediment during pipeline construction and burial. The jetting away of the substrate from beneath the pipeline will result in suspension of sediments which may be rich in pollutants as previously discussed. The sediment plume will move away from operations in the direction of the current. The plume can reach proportions of several yards wide and hundreds of yards long if the substrate is muddy. The duration of sediment suspension depends on the particular size, shape and density of the material suspended and the water's turbulence. After construction, normal pipeline operations will have no effect on the water quality. Adverse long term impacts can result when pollutants are resuspended in the water column. An area that was recently shown to have a high concentration of polluted sediments is Palos Verdes. In this area, the upper 30 cm (11.8 inches) was shown to contain 200 tons of DDT (Young, 1974).

During drilling operations, drilled cuttings may be discharged into the ocean. Most cuttings will consist of sandstone and shale fragments, however, some silt and sand size cuttings may be produced and discharged into the ocean. We estimate that 454 metric tons of cuttings and 20 metric tons of mud (10% of total 200 metric tons) may be discharged during the course of drilling an average 8,000 foot well over a period of 30 days. Considering the amount of drilling mud discharged into the ocean is 10% of the mud used for drilling an 8,000 foot well, the average yearly mass emission rate of barium and chromium from drilling muds will be: 17 - 110 metric tons barium and 0.9 - 5.5 metric tons of chromium for the Borderland proposed sale.

Drilled cuttings discharged into the ocean would be dispersed and fall to the ocean floor. The accumulation density on the ocean floor and the degree of turbidity resulting from drilled cuttings will depend on the current and the water depth in the area of discharge. The increase in turbidity will present a short term decrease in the water quality. This impact will be of low magnitude. Drilled cuttings which have not had drilling muds properly washed out, will introduce chemical constituents which may significantly decrease the water quality.

Drilling muds that are used during drilling operations may be discharged periodically or accidentally into the ocean. Bryant et al. (1974) indicated that Collins (1971) found no detailed studies have been made on the manner in which drilling mud chemicals and drill cuttings may contribute to pollution in the aquatic environment. As revealed in Section III-C.1 & C.2 barium and chromium discharged into the marine aquatic environment may be a potential threat to benthic organisms. Bryant (1974) concluded that current investigations performed onshore in fresh water areas of the Canadian Arctic demonstrate that water base muds, cuttings and other waste fluids can be considered pollutant when waste treatment is not utilized. Pollutant characteristics exhibited by Bryant's (1974) investigations are:

Acute toxicity to fish.

High immediate dissolved oxygen demand.

High concentrations of organic carbon, total nitrogen, phosphorus, solids, chemical oxygen demand, and chromium.

If offshore drilling operations do not dispose of waste materials and/or wastewater onshore then waste treatment facilities should be implemented that will render drilling waste acceptable for disposal to the marine aquatic environment.

The production and discharge of formation waters (oil field brines) has been discussed earlier. Three components or properties of formation waters which contribute to water quality degradation when released into the ocean are: 1) Entrained liquid hydrocarbons, 2) dissolved mineral salts, and 3) absence of dissolved oxygen. A list of oil field brine physical and chemical characteristics are shown in Table III-3 (Effluent from La Conchita Treatment Plant) and Table III-4 (Range of Constituents in Offshore California). The brines from the La Conchita Plant are discharged from the onshore treatment facility which provides service for two platforms in the Santa Barbara Channel. The concentration of constituents normally found in oil field brines and seawater is seen below:

COMPARISON OF SEAWATER AND OILFIELD BRINE 1/

	Seawater 2/ (mg/l)	Oilfield Brine (mg/l)
Na^{+1}	10,600	12,000-150,000
K^{+1}	400	30- 4,000
Ca^{+2}	400	1,000-120,000
Mg^{+2}	1,300	500- 25,000
Cl^{-1}	19,000	20,000-250,000
Br^{-1}	65	50- 5,000
I^{-1}	0.05	1- 300
HCO_3^{-1}	?	0- 1,200
SO_4^{-2}	2,700	0- 3,600

The range of oil field brines found in the offshore areas of California (Table III-4) have mean concentrations at approximately the low end of the oil field brines on the previous table.

During the initial period of oil production, oil may be extracted from shallow formations (Miocene), while later in the life of the oil field oil may be extracted from older formations (Eocene) found at deeper depths. The chemical and physical properties of the oil and associated water can change considerably from one formation, formed during a particular geological time and environment, to another formation formed in a completely different environment at an earlier geological time. Therefore as new wells are drilled and old formations depleted, the elements and their respective concentration in formation

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1/ EPA, 1974

2/ Approximate average composition of ocean water.

waters from a platform will change over the operational lifetime. Although heavy metal concentration within formation waters (oil field brines) of Southern California are usually low, it is possible that formation waters could have high constituent concentrations, depending upon the formation in which the oil is found. For example, in Table III-4, from EPA (1970), mercury is found to be in a range of 0.0005 to 0.002 part per million. Yet, in the Cymic Fields near Santa Barbara, White (1970) indicated that the crude oil had concentrations of 2 to 21 parts per million and the formation water had a concentration of 100 to 200 parts per billion (the report indicated that the results could be high and concentrations should be redetermined by current methods of analysis).

High concentration of dissolved mineral salts of formation waters act as a degrading water quality factor, when salt concentrations deviate from the average. In the Borderland the ambient salinity is found to be 33 to 34 ppt. Salinities of formation water have been found to be from values of less than the borderland's ambient condition to a high of 625 ppt, found in Michigan. The California formation waters presently range from 22 to 40 ppt. Formation waters have also been found to devoid of dissolved oxygen.

Wells that are in initial stages of production may have formation waters which represent 20-30% of the total extractable fluid. As the oil reservoir is depleted the amount of formation water increases. The maximum amount of formation water produced during the life of oil production will be approximately 2-3 barrels of formation water per barrel of oil produced (EPA, 1974).

Within the proposed lease area the maximum oil production case will be approximately 1.6 - 14.0 billion barrels of oil. With the oil extracted over a forty year period, the expected daily production of oil and formation water will be from 4.6 - 40 million gallons per day each. Considering the maximum amount of formation water production (2-3 bbl formation water per bbl oil produced), we can anticipate 9.2 to 120 million gallons (0.22 to 2.86 million bbl) formation water produced per day and a minimum (20% - 30% of the total extractable fluid) of 0.92 to 8.00 million gallons (0.02 to 0.19 million bbl formation) produced per day.

The degree to which operators comply with OCS orders in the discharge of formation waters with entrained liquid hydrocarbons can be seen in examples from the Gulf of Mexico. In the Gulf of Mexico many platforms are disposing of treated formation waters where the treatment equipment puts out an effluent less than 25 ppm oil content, but many older platforms are not accomplishing this. Other locations only manage to meet the requirements of OCS Order No. 8, releasing waters with entrained oil averaging less than 50 ppm.

For the maximum oil production of the proposed areas, with operators just meeting the OCS orders, 460-6000 gpd (11-143 bbl/day) of oil may be discharged to the marine environment through the discharge of formation water. The oil discharged from formation waters, with operators reducing the concentration of formation water effluent to 25 ppm oil, will be 230-3000 gpd (5.5-71 bbl/day). Formation waters from OCS platforms in the Santa Barbara Channel have an effluent with oil concentrations of 1 to 33 ppm with an average concentration of 10 ppm. If this average treatment level is maintained in the lease area, 92-1200 gpd (2-29 bbl/day) of oil will be discharged into the Borderland waters from formation waters.

With many of the proposed lease tracts in close proximity to State waters it is possible that water masses containing discharged formation water could be transported into these areas. With the patterns of water circulation that exist in the Borderland, we can estimate that many of the proposed lease tracts near State water may be potential sources of pollution for State waters. To delineate the trajectory of potential formation waters accurately, physical oceanography monitoring at specific sites must be carried out. Also, the discharge depth of the formation waters, concentration of the consituents, and diffusion characteristic of the discharger needs to be identified before pollution distribution can be adequately described.

Comparing the effluent constituents (Table III-4) with the effluent limits set by the State of California, i. e. concentration limits not to be exceeded 10% of the time (10% standard) and concentration limits not to be exceeded 50% of the time (50% standard), it is found that effluent constituents exceed the state limits by large factors in many cases. Comparing the present formation water constituents range and the State of California effluent limits is shown in Table III-26. In comparing the known upper range of California offshore effluent constituents with the 10% state standard, copper and cyanide are shown to fall below 100% of the state effluent standard. As with the 10% state standard copper and cyanide are the only two effluent constituents which are below 100% of the state 50% effluent standard.

In general the potential formation water mass emission rates (metric tons/yr.), shown in Table III-27, are lower than the municipal discharges (Table II-86) for low flow rates (0.92 mgd) and are approximately equal to the average mass emission rates, for some of the constituents, at high potential flow rates (120 mgd). For the potential formation water elements, shown in Table III-27, it is calculated that their emission rates will range from 0.01% to 12.% of the approximate total (5 major Southern California waste water discharges, 1973) mass emissions

Table III-26 Comparison of California Formation Waters with the Maximum State of California Effluent Limits

Effluent Constituent	State of California Effluent Limits		Range of California Formation Water Effluent Expressed as:	
	10% Standard mg/1 1/	50% Standard mg/1 2/	Percent of State 10% 1/ Effluent Standard	Percent of State 50% 2/ Effluent Standard
Arsenic	0.02	0.01	5 - 400%	10 - 800%
Cadmium	0.03	0.02	67 - 100%	100 - 900%
Total Chromium	0.01	0.005	200 - 400%	400 - 800%
Copper	0.3	0.2	17 - 39%	25 - 58%
Lead	0.2	0.1	NA - 140%	NA - 280%
Mercury	0.002	0.001	25 - 100%	50 - 200%
Nickel	0.2	0.1	50 - 145%	100 - 290%
Silver	0.04	0.02	75 - NA	150 - NA
Zinc	0.5	0.3	10 - 640%	17 - 1067%
Cyanide	0.2	0.1	NA - 2%	NA - 4%
Phenolic Compounds	1.0	0.5	35 - 210%	70 - 420%

1/ Concentration not to be exceeded 10% of time.
2/ Concentration not to be exceeded 50% of time.

into Southern California marine waters. With the municipal waste waters composed of constituents from many sources and this (formation waters) potential mass emission increase from only one of the multiple sources from oil operations, formation waters discharged into the Borderland can be considered a significant mass emission affect. An example of one of the highest potential constituent mass increases is cadmium. At the flow rate of 120 mgd and with an upper concentration level (presently found) of 0.18 mg/1, cadmium may be discharged into the Borderland at an annual rate of approximately 60% of the total annual cadmium discharge into the Borderlands from the 5 major municipal waste water discharger.

The National Academy of Science (NAS) and National Academy of Engineering (NAE) in 1972 published, "Water Quality Criteria 1972". Within this publication is a summary of marine water pollutants, describing the occurance of metals in the marine environment and what their associated toxic levels are. This summary is shown in Appendix 26. From the recommendations of NAS and NAE, Table III-28 was developed Shown in this table are the concentration limits which represent a hazard in the marine environment, concentration levels which present minimal risk of deleterious effects and application factors to determine lethal concentration limits of the most sensitive organism to a specific metal.

The degree of water quality degradation can be best measured by toxicological limits of organisms, most sensitive to a specific metal

Table III-27 Potential Mass Emission Rates of Trace Metals and General Constituents which could Potentially be found in the Formation Water Effluent of proposed Oil Operations.

Flow (mgd) Constituent (metric tons/yr)	0.92	120
Arsenic	0.001 - 0.10	0.166 - 13.26
Cadmium	0.0025 - 0.23	3.31 - 29.83
Total Chromium	0.025 - 0.05	3.31 - 6.63
Copper	0.066 - 0.15	8.28 - 19.22
Lead	0 - 0.36	0 - 46.40
Mercury	0.0006 - 0.003	0.08 - 0.33
Nickel	0.0013 - 0.34	16.57 - 48.06
Silver	0.379	4.97
Zinc	0.065 - 0.41	8.29 - 530
Cyanide	0 - 0.005	0 - 0.66
Phenolic Compounds	0.44 - 2.67	58.00 - 348

Table III-28 Environmental Hazardous Limit Concentrations of Inorganic Metals in the Marine Environment 1/

	Element	Concentration Equal to or Exceeding Levels Which Constitute a Hazard in the Marine Environment	Concentration Levels Less Than Present Minimal Risk of Deleterious Effects	Application Factor to be Applied to the Marine 96-hour LC50 Data for the Appropriate Organisms most Sensitive to Metal
	Arsenic	0.05 mg/1	0.01 mg/1	0.01
	Barium	1.0 mg/1	0.05 mg/1	0.05
	Cadmium	0.01 mg/1	0.2 µg/1	0.01
2/	Chromium	0.01 mg/1	0.05 mg/1	0.01
	Copper	0.05 mg/1	0.01 mg/1	0.01
	Iron	0.3 mg/1	0.05 mg/1	N. A.
	Lead	0.05 mg/1	0.01 mg/1	0.02
	Manganese	0.1 mg/1	0.02 mg/1	0.02
	Mercury	0.01 µg/1	N. A.	N. A.
	Nickel	0.1 mg/1	0.002 mg/1	0.02
	Silver	5 µg/1	1 µg/1	0.05
	Vanadium	N. A.	N. A.	0.05
3/	Zinc	0.1 mg/1	0.02 mg/1	0.01

1/ Abstracted from: National Academy of Science and National Academy of Engineers (1972).

2/ In oyster areas concentrations should be maintained at less than 0.01 mg/1. In the presence of copper and/or zinc at 1 mg/1 or more, there is evidence that the application factor for cadmium should be lower by at least one order of magnitude.

3/ There is a synergistic effect when zinc is present with other heavy metals, e.g., Cu and Cd, in which case the application factor may have to be lowered by an order of magnitude.

in question, but, until site(s) of discharges are known, organisms for toxicological test will not be known. Hence at this time, it can only be estimated that formation waters which would be discharged into the marine environment of the Borderland, as a result of the proposed lease sale, represent a potential deterioration of the water quality.

The most significant water quality deterioration will be in the immediate areas of formation water discharge. By determining the various dilution factors for constituents in produced formation water of offshore California (Table III-4) and comparing these concentrations with those needed to produce minimal risk (Table III-27), the following was found.*

> Chromium should produce minimal risk on direct discharge.
>
> Arsenic and Cadmium will need to be diluted approximately 10 times to produce minimal risk.
>
> Copper, lead, and silver will have to be diluted by approximately 100 times to produce minimal risk.
>
> Nickel and Zinc need to be diluted by a factor larger than 100 times to produce minimal risk.
>
> Mercury should be diluted by a factor larger than 100 to decrease its hazardous effect.

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* These effects are for potentially the highest metal concentration which may occur in formation waters in the Borderland.

As indicated previously water quality deterioration from formation water discharge will be most significant in the immediate area(s) of discharge and will decrease as the formation water mass is diluted. A water mass within which formation waters are entained, should be of low environmental risk at a distance when the initial formation water is diluted by a factor of 100. Elements which may be synergistic, e.g. cadium, chromium and zinc, can have degradative qualities below the indicated dilution level if another metal of a specific concentration is present. Although formation water constituents may be below environmental risk concentrations and produce non-synergistic effects, synergistic effects could be incurred by the formation water mass intruding a water mass within which metals of municipal waters would promote a synergistic effect.

Due to many factors which will contribute to the physical and chemical characteristics of formation waters, only rough estimates (previously discussed), can be made to the extent of the impact from these waters. With the characteristic of the formation waters changing during the life of the oil field, treatment facilities will have to change to combat any potentially changing pollutants. Without treatment facilities being upgraded to combate pollutants, which may not be properly dispersed, it is concluded that formation waters represent a potential significant hazard which will degrade the water quality and may have irreversible effects on the marine biota. Injection of formation waters into depleted, producing, or unrelated formations will eliminate this affect on water quality.

In the past many polychlorinated biphenyl (PCB) liquids were used as heat exchanger fluids in the break down of oil-water emulsions. Concern over extreme toxic effects of PCB has caused discontinued use of PCB in the Gulf Coast. All Federal areas of the Outer Continental Shelf offshore California will be prohibited by the USGS Supervisor from the use of PCB's.

Water quality could be further degraded as the result of accidental oil spills. The USCG estimated that oil and other pollutants spilled in U.S. waters had decreased from 15.3 million gallons in 1970 to 8.9 million gallons in 1971 (Oil & Gas Journal, November 27, 1972, pg. 51). Offshore facilities were estimated to contribute 7.5 percent of the total. This amounts to 43 barrels per day from operations that produced approximately 1.6 million barrels of crude oil per day. It is estimated, that with no further pollutant spill reduction or increase in the United States, the spill ratio is 27 barrels per million barrels produced. With the range of production for the proposed lease sale from 1.6 billion barrels to 14 billion barrels it can be calculated that the probable oil spilled during the life of the field may be from 43,200 to 378,000 barrels of oil. With an increase in technology and a more than adequate precaution philosophy the spill potential volume could be reduced, but with an increase in the number of spills or the volume of the mass spilled, the spill ratio could be increased. Potential large spills resulting from proposed oil operation can be assumed to be of the same order of magnitude as the 1969 Santa Barbara oil spill. Possible spills of this type will involve a total of 4.2 million gallons (100,000 barrels) of oil spilled over a 61 day period.

A single spill of this size would discharge more than twice the total estimated volume of spilled oil allotted for the low production estimate. In addition to major spills, additional barrels of oil per year may be released through minor spillage. Part of this spilled oil would be removed by cleanup operations, some would evaporate, and the remaining proportion would probably be dispersed into the waters of the California OCS. Oil discharged to the marine aquatic environment from major and minor spills and oil within formation waters will add significantly to the reduction of the marine water quality.

Approximately 20% of an oil spill is evaporated. EPA (1974) indicated the remainder of the non-volatile oil acts as a source of pollution, absorbs onto clay particles, settles to the bottom and remains as a source of pollution and depletes dissolved oxygen by oxidation of chemical (dissolved gases such as hydrogen sulfide) or biological (petroleum) products. Tests performed on oil to show general toxicity levels by EPA, show that aromatics are the most toxic, nephthenes and olefins are intermediate in toxicity and straight paraffins are the least toxic. Petroleum hydrocarbons may also act as a mobilization mechanism for chlorinated hydrocarbons.

Factors contributing to the impact on water quality are: potential for dispersion of oil spill, direction of oil transport, present degree of water quality, potential to absorb oil without exceeding an arbitrary threshold and possibility of pollutants reaching maximum acceptable concentrations. The deterioration of water quality as a result of the above factors, on possible locations of oil spill impact, are shown in Table III-29 of Probable Trajectory and Impact Potentials. Water quality conclusions of this table are:

1. There is a low possibility that an oil spill in the outer banks will affect water quality of mainland or island areas.
2. Spills occurring in outer banks will likely be dispersed. Those spills adjacent to the islands and mainland have a possible chance of having circulation restricted within a local nearshore area. Thus low amounts of oil dispersion with a high impact on water quality impact is expected.
3. Much of the proposed lease sale area has pristine water quality. These areas, relative to mainland low quality water areas, have a large capacity to absorb oil spill pollutants before reaching lethal concentration levels. Although these waters have a capacity to absorb pollutants, large changes in water quality could have a catastrophic impact on the local biota.
4. Areas (harbors) of already high toxic loads could reach maximum acceptable toxic concentrations with lethal dose levels thus resulting.

These conclusions thus indicate that potential oil spills offer significant amounts of water quality deterioration.

Table 29

Table of Probable Trajectory and Impact Potentials

Area Affected Environmental Factor*	Nearshore Locations		
	Mainland Areas	Island Areas	Outer Bank Area
Circulation Probability of currents transporting oil out of area.	Low to almost none	Good to low	Extremely high
Probability of outer bank oil spill being transported to area.	Possible	High	
Probability of mainland oil spill being transported to area.		Possible	Low
Probability of local circulation restricting oil from being transported out of area.	Coves, Bays & Harbors: High General Basin: possible	Coves & Bays: Good to High Outer Island coast: Low	Almost none
Present degree of water quality	Low to high: Present ocean discharge areas and some harbors along Los Angeles and parts of Orange County have extremely low water quality.	Pristine: lacking only from boat traffic and small areas of population.	Pristine

Table 29 (cont.)

Table of Probable Trajectory
and Impact Potentials (cont.)

Potential for area to absorb oil spilled pollutants without exceeding arbitrary threshold	Almost none to Good	High	Extremely high
Possibility of pollutants, as a result of an oil spill, reaching maximum acceptable concentrations	Unknown	Coves & Bays: Possible Outer Island coast: Low	Water column: almost none Ocean floor: unknown

*Probability Ranking

1. Extremely high
2. High
3. Good
4. Possible
5. Low
6. Almost none
7. None

G. Impact on Ship Traffic and Navigation

Offshore activities within the Southern California area will have an impact on ship traffic and navigation. The impact will be on a variety of offshore activities. These activities may be classified into three major groups, each of which has distinctive characteristics which can be used to measure any impact which will result in conflicts with vessel traffic and navigation. The three major groups are: (1) Summary exploratory drilling, (2) development well drilling, and (3) production operators. See Section II.G.4. for a description of Ports and Shipping.

Summary Exploratory Drilling

During the first phase of a project the negative impact on ship traffic and navigation will be short term and disruptive in nature. With the added number of vessels in the area performing exploratory and investigative activities, some conflicts may arise with vessel movements in the vicinity of major traffic areas. The exploratory vessels will be crisscrossing areas in the process of performing investigative analysis and will not be travelling in the customary directions and courses for the area. The impact will be on shipping but will not affect the normal navigation procedures.

Development Well Drilling

During the development well drilling operations many of the impacts noted above will still be present on a short term basis and will be disruptive in nature.

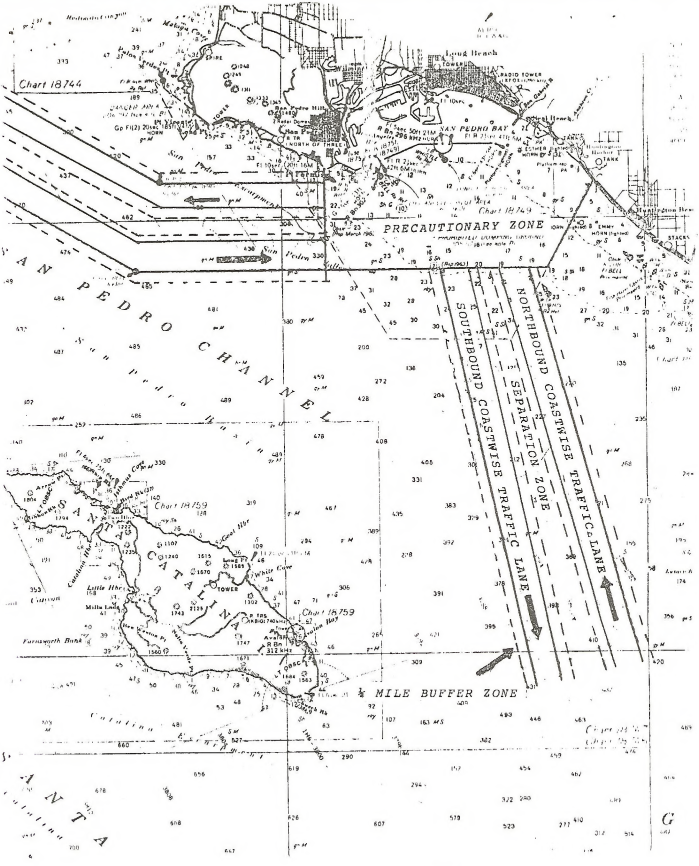
The drilling operations will involve construction of structures on the ocean floor and above water which will need to be observed by ship crews when traversing waters in the area. In addition to structures in the water the logistics function will increase ship traffic between the offshore locations and the ports. Small craft will provide shuttle runs between the coast and the offshore sites during normal supply replenishment activities and workcrew transport.

Another impact activity will be related to the construction of pipelines to the shore. During the construction operations slow moving vessels will be in the vicinity during the trenching and pipe laying phase. The logistics related ship traffic will also add to vessel traffic in the coastal zone.

The navigation hazards will result from the placement of permanent structures in the water where, in the absence of designated shipping lanes, ocean vessels must increase their caution during passage. The pipeline activities will be disruptive in nature and will terminate once the lines are completed.

Production Operations

During this phase of operations the impact on shipping and navigation will result from the offshore structures and trips by service vessels. In the event that subsea completions are required, then the impacts will be minimal since all devices will be on the ocean floor and not above water. The possibility of a major sea going vessel-platform collision is minimized since established sea lanes currently extend from Point Conception southerly to Point Fermin. As of January 1, 1975 the U. S. Coast Guard established sea lanes in the Gulf of Catalina. The lanes, which extend south from Long Beach passing through San Pedro Bay, consist of a one-mile-wide northbound and southbound sea lane with a two-mile-wide separation zone between the lanes. See accompanying figure. In addition, no platforms are allowed to be constructed within one-quarter mile of any sea lane.



GULF OF SANTA CATALINA
TRAFFIC SEPARATION SCHEME

An analysis of the 159 Federal OCS accidents related to oil and gas operations from 1956 to 1973 indicates a minimal impact on shipping and navigation. During that period three accidents were recorded of ships colliding with an offshore structure.

In areas where pipelines to shore are not feasible then an added hazard of barge or tanker traffic will occur. The barge or tanker fleet will be used to transport the resource from the offshore site to onshore sites or other West Coast ports and will add vessel traffic in the vicinity.

The impact of a marine transportation system would have two primary aspects. One aspect concerns the additional vessel traffic that would result, possible tank-cleaning and deballasting operations in the open ocean, and the fact that tanker traffic would pose an oil pollution threat due to potential accidental discharge along any proposed route including loading and unloading operations. The second aspect concerns the quantification of the oil pollution threat in terms of volume of oil that could be unintentionally discharged and in terms of the number and location of the spills that could comprise the unintentional discharge.

The impact on vessel traffic frequency and the intentional and unintentional discharges that would result from operations of a tanker or barge system would be primary impacts on the existing environment. They also would, in turn, constitute secondary impacting effects on various resources along the marine route, such as fish, birds, marine mammals, and recreational potential.

In addition to increased marine traffic from offshore production in the present study areas, additional traffic may be expected from production in the Santa Barbara Channel and the North Slope of Alaska. It is estimated from the USGS's Environmental Impact Statement that marine transportation of crude oil would result in approximately a 3 percent increase in Santa Barbara Channel traffic for the life of the producing fields. The increase at the discharge port of Los Angeles-Long Beach would be less than 2 percent.

Alyeska (APSC, 1971a) has also forecast the changes in tanker traffic at west coast ports. In their 2 million bbl./day model, considering west coast ports only, Puget Sound would have 0.35 tankers per day with North Slope crude and 0.12 without; San Francisco, 1.28 with and 1.12 without; and Los Angeles, 1.22 with and 1.69 without; giving a total of 2.85 with North Slope crude and 2.93 without, a difference of 0.08 ships per day for the whole west coast.

Oil Discharge

Intentional oil discharge could occur from ship tank-cleaning and deballasting operations in the open ocean. Unintentional oil discharge could occur during transfer operations and as the result of ship casualties in restricted waters, open waters, and in the open ocean. Vessel oil discharges are discussed in detail in sect. III.A.2.

As described by the U.S. Coast Guard (1972), at the present time the single largest source of intentionally discharged oil on a world-wide basis is from tanker cleaning operations.

The nature of these intentional discharges are such that oil spill contingency plans, control, and clean-up procedures are not applicable.

Unintentional

Unintentional oil discharge has been analyzed by the U.S. Coast Guard (1972) using two different data bases; one is a 1969-1970 world-wide tanker casualty analysis, and the other is the Coast Guard Pollution Incident Reporting System (PIRS) data for 1970. These analyses treat both the total volume and pollution incident frequency aspects of unintentional loss. The PIRS system of data collection and processing was established in 1970 as part of increased Coast Guard activity in the enforcement of oil pollution control laws of the United States.

Any proposed tanker traffic would clearly pose a pollution threat to specific resources over some parts of a route where such a threat does not now exist. It would similarly increase the threat over parts of the route where tanker traffic is already established.

The 1970 Coast Guard PIRS data for U.S. waters indicate that about 0.00015 percent of all oil transferred is spilled, which would mean that for the 750,000 barrels/day estimated 1987 production for this proposal would amount to an average spillage of 1.12 barrels/day. Peak production in 2008 of 1,000,000 barrels/day would result in a 1.51 barrels/day average and that an average of 0.0091 accidental discharges per transfer operation occur.

The 1970 PIRS data also indicate that about 0.00009 percent of all oil handled is accidentally discharged in restricted waters (harbors and entrances) and that an average of 0.003 accidental discharges per operation occur, resulting in .67 barrels/day 1987 and 1.15 barrels/day 2008.

The analysis and modeling of casualty incidents and pollution-causing casualties on the basis of the 1969-1970 world-wide casualty analysis is extremely tenuous. This is due to the nature of the data base available, including lack of specific information on (1) spill volumes in relation to spills at different locations, (2) spill volumes in relation to ships of different sizes and types, (3) number of trips made by vessels of different sizes, (4) incident occurrence in relation to vessel traffic density, (5) incident occurrence in relation to restriction of waterways, and (6) relation of crew training, ship age, and equipment to casualties. Although these shortcomings make it impossible to quantify the influence of traffic density, restricted waterways, older ships, etc. on the casualty data, it is likely that the world-wide figures are strongly influenced by a large number of casualties in such high traffic areas as the English Channel. The generally low vessel population all along the proposed tanker route suggest intuitively that any model constructed from the historic record in relation to the proposed system would approximate a "worst case" situation.

Porricelli, Keith, and Storch (1971) suggest that estimation of the number of casualty incidents, including pollution-causing casualty incidents, is best approached on a per voyage basis. Their information from the world-wide casualty analysis gives a 0.000357 grounding or collision caused pollution incident per vessel per port call. The Gulf Oil Company made a statistical analysis of tanker accidents for part of the world tanker fleet for the same years and derived values for casualties due to collision, structural failure, grounding, fires, and non-tanker cleaning explosions for tanker size classes and concluded that a per port call basis analysis had the best predictive capability. On that basis, and lumping all ships sizes together, an average of 0.000503 casualties per ship visit was calculated to occur. Some unstated part of the casualties analyzed by Gulf resulted in pollution incidents.

Any incidents within the contiguous 12 mile zone would, as mentioned previously under restricted waters, require execution of contingency plans to control and clean up spilled oil. Any incidents in the open ocean could be beyond the effective range and scope of contingency operations. However, any open ocean spill that threatens U.S. or state waters would be subject to contingency operations.

Summary

The prediction of the volume of oil loss and of the number of unintentional oil loss incidents from different causes at different places is an important part of the evaluation of the primary and secondary environmental impacts of the proposed system. The data base available for such projections is very short and includes the effects of many incompletely evaluated variables.

However, present estimates for this proposal indicate that for a production of 750,000 barrels/day in 1987 and 1,000,000 barrels/day in 2008 that 1.12 barrels/day and 1.5 barrels/day respectively would be spilled during transfer operations. Of this, .67 barrels/day 1987 and 1.15 barrels/day 2008, would be in restricted waters.

Contingency Plans

Effective contingency plans covering the discovery and notification, containment and countermeasures, clean up and disposal, and restoration phases of any potential spill are essential to proper operation of any marine oil transfer terminal and tanker transportation system. The various estimates given previously in this section suggest that even with the best available technology and controls, some oil would be spilled from the proposed system. Spills of various size would be expected; most would be minor and considerably smaller than the average, some medium, and some major (U.S. Coast Guard, 1972). Contingency plans are either developed or being developed for all major U.S. ports.

In the area that would be involved in the proposed Southern California operation, industry cooperative plans are already in existence or under development. These plans would require review and amendment or modification as appropriate to encompass the increased activity that would result from oil development. This is considered a continuing process for any contingency plan and the arrangements for oil spill removal. No extraordinary procedures or efforts are considered necessary in the west coast area by the U.S. Coast Guard (1972).

The Southern California area contingency plan should establish suitable procedures to ensure a proper response to any spill that might be anticipated in that area. It should consider such factors as critical uses, environmental factors, available resources and permissible clean up techniques, as discussed in detail by the U.S. Coast Guard (1972). The Coast Guard (1972) does not consider it necessary to require the terminal operator to have equipment immediately available to respond to every possible spill, but they do state that plans and arrangements should be made to provide full response equipment for the maximum possible spill within 12 hours of spillage at any point in the area. Contingency plans are discussed in greater detail in section IV. C.

H. Conflict with Military Uses of the Continental Shelf.

The entire continental shelf of Southern California extending from 3 nautical miles to some 160 nautical miles offshore is used by some facets of the military for various types of operations.

The major portion of the continental shelf off Southern California falls within the Pacific Missile Range which covers some 29,000 square miles and extends approximately 160 nautical miles offshore. This area is used for jet powered target flights, tactical missile launches and flights, manned and unmanned aircraft flights, bomb drops, anti-submarine warfare weapons, and general gun firings.

South of the Pacific Missile Range, extending to San Diego and at varying distances from the coast are several Naval operations areas (described in COMTHIRDFLT INST 1973); Long Beach Electronic Test Area, San Pedro; Channel Operations Area; Santa Barbara Island Training Area; San Clemente firing area; Shore Bombardment Area (San Clemente Island); Anti-submarine Rocket Training Area; Camp Pendleton Amphibious Training Area; Cortez Bank Carrier Operations Area; San Miguel Island Naval Danger Zone. These areas are used for all weather fleet training, refueling, test flights, rockets, bombs, anti-submarine warfare, all weather flight training drones, carrier and submarine operations, anti-aircraft and surface gunnery and miscellaneous military operations.

Included in the above areas and extending through the Pacific Missile Range are the following submarine transit lanes into the Port of San Diego; Sierra Venus, Sierra Mars, Sierra Apollo, Sierra Pluto, and Sierra Zeus.

In addition to the above operations areas there are two smaller areas of interest: the small arms practice firing range for the United States Army Reserve, National Guard, and Coast Guard units off of Point Fermin (patrolled during firing sessions by safety observers), and the Santa Cruz Anti-submarine Warfare Test Facility, located south of the eastern end of Santa Cruz Island.

Access to all of the aforementioned operation areas is controlled during hazardous operations by radio broadcasts, patrol craft, and notices in "Local Notices to Mariners" published weekly by the Local Coast Guard District.

For several months staff personnel of the Department of Defense, Navy Department, Department of the Interior, Bureau of Land Management worked together in an effort to resolve conflicts between military operations and proposed oil and gas leasing and development. Personnel at both the Washington and field levels were involved in the effort.

An agreement was reached Friday, May 3, 1974 in the areas offshore Southern California where oil and gas leases could be offered without major disruption of DOD operations in the area. However, the successful exploration of the area will cause some dislocation of the Pacific Missile Range and the Long Beach Electronic Testing area. This relocation would cost between $18 and $21 million, of which $5 million would be for military construction.

I. Impact on Recreational, Historical, Archeological, Esthetic and Conservation Resources

1. Beach and Shoreline Recreation

For the purpose of analyzing the impacts on beach and shoreline recreation, the life of hydrocarbon leases will be broken into four stages; exploration, development, production and abandonment. Outdoor recreation is an important component of the Los Angeles environment. Some opportunities are in extremely limited supply and swimming beaches are in this category. Even though beaches are abundant in Southern California, the combination of auspicious climate and a large, highly mobile population creates a demand which far outstrips the supply. Any loss in opportunity for one resource such as a beach defiled by oil, will likely be made up by persons seeking alternative recreation elsewhere, such as going to another beach, going hiking in the mountains, or any of numerous other options. While this represents no net loss to society in terms of foregone opportunity, it does create a loss due to the increased crowding occasioned at the alternative activities selected, and thus may be a depreciation of quality for those alternatives. Capacity is limited both physically and by regulation at many sites.

Beach and shoreline activities susceptible to oil related impacts include surfing, swimming, skin and scuba diving, sunbathing, sightseeing, and fishing. Fishing can be broadly construed to include diverse activities ranging from surf fishing and clam digging, to grunion hunting.

There will be overlaps among the various development stages, but individual stages will tend to dominate varying periods through the life of the lease.

Exploration

During this stage, geophysical data is being gathered. This consists of bathymetric, seismic, gravity, magnetic and presence of hydrocarbons information gathering. Test holes or wells may also be drilled. The greatest effect will be in increased marine traffic which should have minor effects on beach recreation. Ocean solitude would be affected somewhat by increased activity. Nearby seismic data gathering could affect divers if explosives are used. Onshore effects would be due to congestion and increased activity around airports, harbors or mustering areas.

These activities are currently engaged in in the Bight but their tempo will undoubtedly increase if this proposal is implemented. Exploration lasts for five years after the signing of leases and will be considered as part of the development process after that time period. Development activity will extend to about 1985. Individual disruptions for nearby recreationists would be on a scale of a few hours and be entirely temporary. Disruption of solitude on wider areas of ocean could persist for several days to weeks at a time but be minor in overall impact.

Development

In the development stage of lease areas, platforms, pipelines, separation and storage and support facilities are being built. Wells are being drilled from barges and platforms. Most population increases or dislocations, if they occur, would occur at this stage, resulting in increased pressure on local recreation facilities. Other onshore impacts would occur where the storage of construction material or building of mustering areas caused a change in land use or aesthetic damage. If located near existing or potential recreation sites, their environmental quality could be seriously degraded. Such changes in land use would also affect wildlife observation opportunities on land which is presently undeveloped and in near natural condition.

Construction of industrial sites in rural areas would result in increased pressure on existing resources, changes in aesthetic quality and higher land values. This could make recreation land acquisition more expensive. Wildlife habitat destruction or alteration through land use change would be detrimental to recreational uses of wildlife. Loss of open space will also occur. The probability is high that oil-related industrial sites will be proposed for rural portions of the Ventura and Orange County coastal area. In Ventura or Orange Counties the loss would involve existing recreational uses in many cases.

Platforms will not physically interfere with beach or near shore activities as they will be a minimum distance of three nautical miles offshore. They will, however, be very visible and have an aesthetic impact on beach users. Platform placement and attendant activities in waters near San Miguel, Santa Rosa, Santa Cruz, or Santa Barbara Islands may create enough disturbance to certain species of birds and animals indigenous to those islands to result in their disappearance. This would be a very real,and in the case of rare or endangered species, such as some of the pinnipeds and the brown pelican, irreversible and irreplaceable loss to those people who value these creatures and enjoy watching them for rest and relaxation.

Vessel traffic will be greatly increased, shuttling men and equipment between shore and drilling sites. The impact would be visual and not particularly deleterious as ships and boats are generally accepted to be part of the ocean scene. Small oil slicks from these vessels are also considered to be adverse to recreational values.

Because of hazards present during development drilling, boaters may be restricted from the vicinity of platforms while this activity is under way. The four areas where travel restrictions may cause the greatest inconvenience are the tracts in Santa Monica Bay, and San Pedro Bay and the Santa Rosa-Cortes North and Santa Barbara-Catalina tract groups. The further most area, Santa Rosa-Cortes South, does not attract as much boating activities because of the distance from shore. This will be a minor loss probably more than offset by the subsequent attractiveness of the platform vicinity for sportfishing. The total amount of boating activities to be disrupted will depend on the time of the year, the size, location, and scope of the projects involved.

Impacts upon recreation activities can be caused by the many activities precipitated on shore in support of offshore drilling. Construction of equipment storage and marshalling yards, communications and navigation facilities, transportation centers and associated urban development will all affect recreation. Equipment yards could infringe upon shoreline recreation by converting the backshore to non-recreational use, restricting access to the shore, converting wildlands to industrial sites and by altering area aesthetics. Communication sites would generally be visible to all and could usurp land from recreational usage. Transportation support could remove nearby coastal land and open space from recreational use. Induced urbanization will result from the influx of workers who will be involved with an expanded oil development. A maximum increase of 14,953 workers could be expected within a 15-20 year period. These workers would increase the total population by as much as 35,887 with their families included. This type of increase places additional demands on area recreation resources. At an average of five acres of local park acreage per 1,000 people, this would create an additional need for 179 acres. This impact would be scarcely felt if it occurred in heavily populated portions of Los Angeles or Orange Counties, but would be very noticeable if it occurred in an area such as Ventura County.

Onshore development which takes place on any of the offshore islands would have a potentially serious impact on existing and potential recreational values there. Many of the islands, particularly the northern Channel Islands and Catalina are likely prospects for pressure. All of the islands' surrounding waters receive heavy visitation, with San Nicolas and San Clemente receiving lighter influxes due to greater distance and military restriction. Landings are restricted at all of the islands with the exception of Santa Barbara Island, the two easterly islands of Anacapa and portions of Catalina. This limits the onshore recreation benefits of those islands but does contribute to the solitude and naturalness of them, which is their major value. Negotiations with the private owners of Santa Rosa and Santa Cruz Islands may be successful and add these islands to a Channel Islands National Park at some future date. This park has great potential from a developed recreation, archeologic and ecologic point of view. Further additions could come from military relinquishments of the other islands. Due to the relatively pristine condition of these islands and their endemic flora and fauna, construction of any facilities on any of the islands should be considered as adverse to recreational values.

San Miguel, San Nicolas and San Clemente Islands are all military reservations and could be used by private industry only with the Department of Defense's permission or if they were declared surplus totally or in part and sold. Anacapa and Santa Barbara are parts of the National Park System and not likely to be used for anything other than their current uses. Catalina is privately owned and used for conservation purposes. Much of it has been turned into open space and park use under an agreement with Los Angeles County. The possibility exists, though remote, that a portion of it could be sold or leased for such purposes as separation and storage facilities, equipment yards and communication sites. The Coastal Zone Conservation Commission, Los Angeles County Planning Department and State Lands Commission would have to be satisfied before this type of land use could take place.

Santa Rosa and Santa Cruz Islands are privately owned and used for ranching purposes. Though they have been retained in rural usage, the same possibilities exist with them as at Catalina. Santa Barbara County officials would have responsibilities along with the two State agencies for approving activities of this nature.

Proposals to use some of the islands for oil-related industrial sites have been expressed by the industry and their implementation would constitute an adverse impact probably for the duration of the project. It is possible to restore the sites for recreational use once the project has ended.

If the pipelines estimated to result from this proposed sale are brought ashore in a beach area used for recreation, there will be an impact on recreational activities. The area of a beach disturbed by pipeline construction will be small (about 30-50 feet wide), and the first high tides following burial of the pipeline will serve to restore the beach terrain. Restoration of the beach ridge through natural processes will take longer, most likely requiring a storm tide or high winds to obliterate the effects of excavation. Physical interference with recreational activities from excavation will be minimal and short-lived, lasting for an estimated period of one to ten weeks. Since coastal physiography generally limits the areas in which pipelines can be brought ashore to the alluvial plain areas, adverse impacts to the wetlands which often occupy these places could occur. If this impact occurred, we would consider it to be disruptive for recreational purposes during the period of construction. Since water turbidity would quickly restore to normal, the impact would not be significant nor long lasting.

If pipeline terminal or transfer facilities are located in or near a beach or other area used for recreation, there will be an adverse impact on recreational activities from disruption during the construction phase and elimination of about 40 acres per terminal plant for recreational and other uses. We estimate a total of 400 to 600 acres could be affected as a result of this sale. This latter impact would be long-term and restoration of the area, if attempted at all, would have to await depletion of the offshore production which the plant would be designed to serve. These impacts will also diminish the quality of the area for recreational enjoyment. The construction of a refinery in Ventura County could affect up to 1,000 acres in a way similar to terminal plants.

The impacts of pipeline and terminal facilities construction on recreation would be mitigated somewhat if the appropriate governmental authorities zone effectively and enforce the zoning. The restriction by local or state authorities of this type of construction to the time when recreational use is at its lowest point would also mitigate the impact considerably.

Refinery capacity is expected to increase with expanding demand and be only indirectly related to the hydrocarbon production of the proposed sale. Expansion of refineries is severely limited in the Los Angeles area due to lack of available space. Increased capacity will probably come through modernization at existing installations. If expansion did occur at new locations, recreational impacts could occur. Expansion of existing facilities would produce little impact on recreation except for minor disruption caused by the installation of additional pipelines across beaches. New refinery construction, as discussed previously, could take land informally used for recreational purposes and radically change the character of adjacent public recreation lands. The duration would be long-term and quantification of the recreation impact difficult without specific site proposals in hand.

Hydrocarbons will be transported by a combination of barging and tankers, or pipelines, and the shoreline area involved with landing of the material can be surmised for the combination. Barging will very likely take advantage of existing port and offshore unloading facilities. These facilities exist at Port Hueneme, which already handles much oil field equipment; the marine terminal at El Segundo, the Los Angeles-Long Beach Harbor complex, and the marine terminal at San Diego/Encina. Other potential deepwater port locations in the area are at Hueneme Canyon, offshore Port Hueneme; and Point Fermin. Pipelines from leases in Santa Monica and San Pedro Bays would come ashore at any location. Deep intervening basins and current technology require that any pipelines from Outer Banks lease areas be routed northward along the Santa Rosa-Cortes Ridge to the Northern Channel Islands, then easterly along the island shelf to land in the Oxnard-Ventura area. Any landing point with the possible exception of the heavily industrialized Los Angeles-Long Beach Harbor area, will very likely sustain impacts on the recreation resources in the vicinity.

Barging or lightering can adversely impact recreation through spills which intercept the beach. Barge traffic from lease blocks in the Santa Rosa-Cortes South tracts and the Santa Barbara-Catalina tracts poses a hazard to beaches extending from Oxnard to southern Orange County. These are the heaviest used beaches in the state. The loss of a lighter in the surf could effect a loss of 58,765 visitor days per event.

Production

Wells are producing oil and gas in this phase and manpower requirements are relatively lower than for the development stage. Repairs must occasionally be made to existing wells and pipelines.

Impacts are similar to those of the development phase except that personnel requirements are lower, thus lowering demand for local or regional recreation facilities. Production occurs, usually, for about 20-40 years.

Abandonment

Abandonment occurs after a field is exhausted. The effects would be the lowering of tax bases, with concomitant loss in bonding power to construct new recreation facilities, lessening of financial ability to maintain existing facilities, and esthetic impacts if abandoned equipment is left scattered around. This is prohibited for federal waters but could occur in other areas. Platforms are dismantled so any impacts attendant thereto would be temporary disruption due to wrecking activities and transportation of salvage.

Oil Spills

Oil spills can occur at any stage in the life of a lease, but are more likely to occur during the development and production stages. Spills may be large and infrequent or small and persistent in occurrence. Progress has been steady in prevention and containment of spills but they do continue to occur. Statistical evidence indicates that several spills exceeding 50 bbl will occur if this sale is implemented, and numerous small losses will occur from platforms and vessels. Prevailing wind and currents assure that this oil will reach shore in time, if not contained or degraded by natural processes. In the worst case, a nearshore oil spill on an incoming tide with an onshore wind, could cover beaches in less time than it would take to mobilize containment activities. If this occurred in the summer, and particularly on a mainland shore, recreation losses would be great until beaches and nearby waters could be cleaned. Water sports, such as swimming, surfing, diving, spearfishing, underwater photography, fishing for finfish and shellfish, and boating would be directly affected.

Other seashore related activities such as beachcombing, shell collecting, painting, shoreline nature study, camping and sunbathing would be made much less attractive for an indeterminate period where an oil spill had coated a beach.

Removal of oil from beaches used for recreation in the area under consideration would probably involve removal of the contaminated sand, and possibly replacement of the sand if needed. The time required for clean-up in this case would depend on the extent of beach affected. Recreational use of the area would be precluded during the time that oil covered the beach and during the clean-up process also. We estimate the duration of this impact, if it occurred, to range from one to 60 days.

The impacts of an oil spill discussed above would be more keenly felt if the recreation area involved is intensively used or considered to have unique or outstanding recreational values. Not only would the impact be felt by the recreational users of these areas, but the community of businesses whose economic well-being depends on use of their recreational resources by tourists would be affected as well. If an oil spill were to cover outstanding recreational beaches during the height of the tourist season, the impact could be expected to be more severe in that tourists would not be attracted to a beach area contaminated by oil or undergoing a clean-up process, and there would be a resultant economic loss. Fourteen percent of Southern California's 8.5 million out-of-state visitors indicated beach or coastal visits were part of their itinerary. Thus some portion of 1,190,000 people would be affected by an oil spill. Most likely, a shift of visits to unaffected beach areas would occur but some trip cancellations could ensue. The effects would be local rather than regional in scope.

Esthetically, considerable damage may be wrought for varying lengths of time depending upon the success of clean-up. Most losses will be temporary and partially offset, as many people will avail themselves of unaffected alternative recreation sites or activities, there thus being no net loss to society. Other losses, though temporary, are longer term and thus may represent an intrinsic loss to society. Such damages as bird kills and losses of intertidal animals and marine mammals may be repaired in time but for the duration of their depletion, do represent a loss to those who enjoy watching them or take comfort in knowing that they exist. A more difficult loss to quantify is the damage to the ephemeral or "spiritual" value attendant in an undefiled or untampered environment. This quality is held dear by many people.

Mead and Sorensen (1970) analyzed the cost of the Santa Barbara oil spill and took a recreation survey in the process. Their survey findings as they relate to impacts briefly indicate that: approximately 53% of the respondents stated that they used the beach less in the 12 months following the spill than in the 12 months preceding it. Four percent said they used the beach more after the spill; 37.1% said they visited the beach the same number of times. In more detail, the average (mean) number of beach visits had declined from 27.9 in the previous 12 months to 20.8 in the following 12 months. Thus, their survey indicates that area residents visited the beach fewer times (on average) in the 12 months following the spill. They therefore concluded that an aggregate net reduction of 744,000 beach visits occurred in the 12 months following the spill among Santa Barbara coastal area residents over the age of 16.

Mead and Sorenson (1970) calculated the total loss of recreational beaches for intermittent time periods at $3,150,000 for Santa Barbara and Ventura Counties.

Some tourism losses occurred as evidenced by drops in "bed tax" collections in Santa Barbara and Montecito. Offsetting gains occurred at nearby Goleta which resulted in an overall increase for Santa Barbara County for 1969. They concluded that no over-all loss occurred due to offsetting gains elsewhere within the county and region, although private losses to restaurants and motels near the beach probably did occur.

Small spills will prove to be annoyances more than anything. Beaches throughout most of the Los Angeles, Ventura and Santa Barbara County area are subjected to tar balls from natural seeps in the ocean floor and probably from ships. These frequently are found buried in the sand in the surf zone or tossed on the beach. They are capable of soiling feet or clothing and thus are undesirable.

Small spills or the remnants of large ones may contribute tar balls to the beaches and thus cause a minor impact.

In summary, spills will cause losses which could be major, though certainly not permanent, except where the extirpation of a species important to recreation occurs. [1]

Another important factor affecting potential impacts is changes in land use resulting in open space and recreation land loss. The creation of adequate land use plans, effective zoning and strong enforcement by enlightened local officials will play a large role in the ultimate effect of leasing on recreation and open space.

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[1] The demise of any species either totally or throughout a significant portion of its range is considered a major adverse impact. This section deals solely with recreation, hence the limitation to the recreational context.

2. Esthetic and Scenic Values

Appreciation of esthetic values is inextricably interwoven with many other human pursuits, some of which are measured in terms of dollars or visitor days, and numerous others which are neither measured nor susceptible to measurement. Adverse esthetic impacts frequently do not result in total loss of the resource such as people refusing to go to a beach because of a cluttered view, but rather, some unquantifiable depreciation of their total enjoyment of the experience. Quantification of losses due to esthetic changes must be regarded as minimal levels because of the many "users" who are never sampled. Impact on esthetic values will occur from both normal operations as well as failures such as oil spills. Various stages of development within the proposal sale are analyzed in terms of their impacts from normal operations, and where probable, from accidents. Visual quality is the most important esthetic parameter that we are concerned with in this analysis, followed by sound, smell, and solitude. Analysis of visual impact must presume an observer positioned at a particular location and in this region, observers are to be found in varying numbers at nearly every conceivable position offered by Southern California geography. Untold millions of observers, pass by on the Coast Highway, some on commercial ventures, many commuting, joyriding or visiting and numerous others sightseeing. Residents occupy areas ranging from the wet sand beaches to the commanding heights of ocean bluffs and coastal mountains, such as the Santa Monicas. Chief among the values of coastal homes is the ocean view and participation in the sea environment. Beaches, both private and public, attract millions of visitors during all parts of the year. Offshore, island dwellers and visitors, as well as boaters view vast expanses of the ocean. Viewers from all of these positions derive some fraction of their enjoyment from the coastal and ocean esthetic values. Of all of these categories, recreation visitation is the only parameter commonly monitored and it will be our basis in attempting to assess the impacts on esthetics. Many competent economists have tried to attach dollar values to esthetics and have been unsuccessful. Such attempts are inevitably doomed to failure for many reasons, among them being that social, economic, cultural and philosophic backgrounds vary one's perception of what is esthetic so broadly that a standard definition from which to start is not possible. It is possible to analyze from an artistic or architectural basis what is or is not "esthetic" but it is not possible to quantify the magnitude of non-esthetic features. For example, if a drilling platform is adjudged a discordant feature because it presents disharmony in lines, texture, color or surroundings, it is not reasonably possible to say that its presence depreciates the esthetic quality of the area by ten percent, fifty percent or one hundred percent, because it may not depreciate one observer's enjoyment by an iota, while conversely, totally damaging that of another. In this analysis, quantification will identify only that portion of the viewing public who may be affected in one way or another by changes in the esthetic situation. That portion of the public using the coast's esthetic resource, which is susceptible to some analysis, is the beach visitor, because most managing agencies keep visitation records of one form or another. Boating registration and use figures are available and will be used. Other categories of users are not readily quantifiable. Residents, for example, do not use all of their time enjoying the sea view. The figures developed subsequently should be regarded as minimum numbers as they only consider the measured portion of one segment of esthetic users.

Source of Impacts and Duration

Esthetic impacts will occur both offshore and onshore and be due both to direct and indirect results of this proposed sale. They will range in duration from very transitory to nearly permanent. Some will be attributable to normal activity and others will be caused by unusual or accidental events.

Offshore impacts during exploration will be caused by increased vessel and air traffic engaged in geophysical data gathering. Their activities will include the tracing of grid tracks across the sea during which seismic, magnetic, hydrocarbon and gravity recording instruments will be arrayed. Some noise, occasional small explosive detonations and coring of the sea bottom will occur. This activity currently takes place, though at a lower level than it would if this proposal were implemented. Later in the exploration process, test wells could be drilled and production of hydrocarbons from these wells could be either barged to shore, or flared at sea. Normal impacts accruing would be noise, increased offshore traffic, some vessel oil losses, production of some turbidity from drill cutting and mud disposal, and loss of solitude. Particulates and odors from flaring would degrade air quality to a limited extent. These effects will last for five years to 1980 when the exploration phase as such will terminate. Loss of esthetic values will be minimal consisting primarily of loss of solitude in the ocean areas affected by exploration. We do not foresee any persisting or significant losses, only minor disruption during normal offshore exploration activities.

Onshore impacts during exploration could entail land use change for equipment storage, heliports, communications and navigation equipment construction. Increased traffic around harbors or marinas will have some visual impact. Construction activities could have a deleterious effect, particularly if they take place in areas which are largely natural at present. Communications facilities which occupy prominent high points have a large visual impact potential, both from the facilities themselves which occupy high topographic points, and from access road construction and site leveling. Sensitive design, siting, use of materials and landscaping could reduce the visual impact of the installations while road location, design and construction can be accomplished in a manner compatible with the terrain and hence be visually compatible. There is a distinct potential for some onshore loss of esthetic values in localized areas due to these installations. Those affected would be boaters, possibly residents, and some beach users. The duration would extend through the life of the petroleum fields, approximately to the year 2040, with some lessening of visual impacts as disturbed soil revegetated.

Abnormal or accidental events which could occur during exploration would have adverse impacts. These include such problems as vessel loss, oil spills and landslides. Geophysical vessels or aircraft could be lost resulting in fuel and lubricating oil spills. Barges carrying test production could be lost through accident, thus resulting in oil spills, or flaring equipment could result in oil spills through malfunction. Test wells are supposed to be drilled off structure to minimize the chance of accidental encounter with high pressure zones, but still retain a degree of risk because they are put down in areas which are unknown or partially known. A real risk of blowout exists, therefore, which would produce adverse esthetic impacts.

In summarizing, vessel losses would produce relatively little visual impact as shipwrecks are generally accepted as a "natural" part of the ocean scene when they rest in the surf zone. Oil spills from research vessels will be minor in extent and constitute little esthetic impact. Loss of a barge filled with production would constitute a more serious problem if it occurred nearshore where containment and recovery actions could not be rapidly and successfully executed. At sea under normal conditions, a spill resulting from such a mishap would probably be successfully controlled. Nearshore where a barge may founder on rocks or in heavy surf, control of spilled oil is unlikely and esthetic damage in the form of visual pollution by oil fouled rocks or sand and biological damage will occur. In an accident of this nature, a maximum of 2,000 - 3,000 bbl may be spilled. This would result in an instantaneous calm water spread of about 0.24 square miles or a 2900' diameter slick. In reality this slick would break up in the surf and be transported by longshore drift to come ashore at varying densities along an indeterminate length of shoreline. For purposes of this analysis we presume the slick to move directly onshore, thereby coating the minimum lenth of 2900' (884 m) of shore. Beach capacities or beach density standards are expressed as either persons per lineal foot of public swimming beach or square feet per person. If we adopt a density standard of one person per lineal foot of shoreline, this indicates approximately 2900 persons at one time are potentially affected by this spill. To determine the net effect in quantifiable terms, we have selected the recreation activity pattern most closely related to the esthetic resource. This resource demand is the "Sightseeing and Study" Activity Pattern category utilized by the California Department of Parks and Recreation for its coastal recreation activity demand assessment. In 1970, twenty-seven percent of the south coastal (Pt. Conception to Mexico) state park visitors interviewed had engaged in the "Sightseeing" sub activity portion, expending 26,190,000 activity days.[1] Updating these figures to 1975 demands yields 30,945,000 activity days. Demand by 1980 in this category should reach 35,700,000 activity days out of a

[1] The "activity day" unit is very different from the "recreation day" used in demand charts. An activity day is the participation by one person in one activity on one day. Under this definition, the visitor might therefore be counted one, two, or three, or possibly even four times (though his participation in an activity had to be one of his major purposes for the visit in order to be tabulated). A visitor might surf, swim, and play volleyball in the course of his one day at the area. He would then be counted as three "activity days" because he used all of these activities.

The term "recreation days" merely expresses the number of people visiting, and reflects somewhat the popularity of an area; "activity day", on the other hand, gives some idea of the popularity of an activity and enables us to predict the type and quantity of a natural resource needed to meet the demand for that particular activity.

projected total of 262,300,000 activity days. This represents 13.6% of total activity days. Applying the data to the test case;

2900 visitors
x.27 percent of participants
=783 visitors affected.

The persistence of the beach's oil fouling is purely conjectural as clean-up may successfully restore it within a few days. On the other hand, patches of oil may continue coming ashore for several weeks and oil which sinks into the sand may remain covered for months or years until normal periodic changes in beach sand transport mechanisms cause surfacing of the oil. If sorbents such as straw are used to collect oil, the disruption might occur for approximately one week. Sand removal and replacement could take a considerably longer time period. Based on a one week clean-up period, 4,380 visitor days[1] would be adversely affected. In addition to this category of "Sightseeing" several other activities are interrelated with esthetics, among these being beachcombing, nature study, just relaxing, photography, painting, walking for pleasure and picnicking. It was not possible to determine the degree of overlap among these categories with the data we have, hence the 27% participation in sightseeing cannot be expanded to include, for example, those who indicated photography/painting as a major pursuit and who did not include sightseeing in their answer. This example is presumed to take place during the summer. Winter or other season occurrence would lower the impact due to lower off-season beach visitation.

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[1] Visitor day is defined as one person spending 12 hours at a site, two persons spending 6 hours, etc.

An oil spill due to a well blowout will be discussed in the next section dealing with production impacts.

The last source of exploration impacts is a landslide resulting from improper drainage or siting of a communications facility or other construction activity. An impact of this sort could occur in a location which would make it highly visible, thus affecting millions of viewers over a year, or it could be relatively hidden. No attempt can be made to quantify this type of impact with presently available information.

The development stage is expected to extend from 1975 to 2005 if this proposal is implemented. During these 30 years, wells will be drilled, platforms constructed and placed, storage and processing facilities built, pipelines constructed and barging or flaring of some test or initial production will occur in the offshore area. Onshore, platforms will be constructed in dry docks, barges will be built, equipment storage and mustering yards will be built and land based processing and storage facilities constructed. Normal operations offshore will result in a relative loss of solitude in the areas affected, particularly in the less frequented areas outside of Santa Monica and San Pedro Bays. Shore residents, beach users, island residents and boaters will be affected. A potentially serious loss in the esthetic sense would be the dissolution of the pinniped rookeries present on many of the islands, but particularly, San Miguel. This would be directly attributable to the loss of solitude which these animals require to persist. These constitute the largest assemblage of numbers and species present near a large population center, in this country and possibly in the world. Although not susceptible to massive exploitation such as close-in tours, their existence is a valuable regional and national resource. The loss of solitude would be of short duration in some cases where dry holes were encountered, persisting only a matter of weeks, or lasting for up to 60 years until abandonment of fields where sufficient hydrocarbon resources are discovered. Secondary results of the loss of solitude such as the loss of biological communities could be largely permanent.

Visual impacts will occur in the offshore area from drilling rigs, platform placement, barges, flaring, and work vessels. Small oil slicks from work vessels will appear, particularly in harbors or other confined waters. Drilling will probably produce localized water turbidity of short duration if drill cuttings are disposed of at the site. Loss of drilling mud will affect water clarity temporarily. Pipeline construction will result in temporary turbidity, particularly where burial is required. Platform placement will affect visual quality and is discussed during the production phase. Vessels will produce the same impacts as discussed in the preceding exploration section. Flaring is also discussed in the exploration phase.

Onshore activities during this phase will involve platform and barge construction, treatment and storage facility construction and equipment storage yards. A secondary impact occasioned by the interaction between regional increased product demand and the ready availability of crude supplies, may be the construction of at least one refinery. Platform construction will take place in dry docks, probably in heavily industrialized areas where it will constitute little additional visual impact. If construction facilities are developed in what is now open area, the land use change involving dredging and filling plus the clutter of the structure itself and associated cranes would be a considerable impact. Barge construction will probably take place in the industrialized sector of Los Angeles-Long Beach and thus not constitute much of an impact. Treatment and storage facilities are usually placed as close to the wells as possible which indicates either platform location or nearby shorelines. This is due to the difficulty in moving multi-phase materials through pipelines. Placement of these facilities on platforms would add somewhat to the bulk of the structures but would not appreciably affect their visual impact. Santa Rosa-Cortes North, and Santa Barbara-Catalina groups of tracts are located proximate to various Channel Islands. The northern edge of Santa Rosa-Cortes South lies 15 miles south of San Nicolas Island. All of these islands are largely to totally undeveloped and present views which are rare in Southern California, that of primarily native vegetation on unaltered hillsides. In addition, many of them have the unique biological assemblages alluded to earlier. The placement of facilities on these islands constitutes the greatest single impact potential in terms of alteration of natural regimes, thereby changing the esthetic environment. Visual impact could range from high to low depending upon the sensitivity of siting, earthwork quantities, jetty construction, structure design, use of colors and subsequent landscaping. Placement of these facilities in shoreline areas of Santa Monica or San Pedro Bays would affect far greater numbers of people but would effect much less change in the existing conditions than would use of islands. This is particularly true in portions of San Pedro Bay where the shoreline is already heavily industrialized and little change would be evident with the addition of more facilities. In the Orange County portion of the San Pedro Bay tracts, the shoreline is either undeveloped or primarily recreational-residential. Siting of facilities in these areas would present a visual as well as an olfactory impact. The duration of the impact would equal the life of the field or about 40 years. An estimated 7-15 of these facilities will be necessary. Boaters would be able to view these facilities if they are sited near the shore. We estimate that those people who listed cruising, sailing or fishing as their main boating pursuits, will in some way be affected by these facilities. Based on this, approximately 2,000,000 visitor days will be in some way affected. No estimate will be made of the number of viewers who will be affected as residential viewers or as passersby on the Coast Highway or nearby streets.

Due to the restraints of existing air quality, available land and crude transportation costs, refinery construction will most likely not take place in the Los Angeles metropolitan area. The most probable location would be in the near-coastal areas of Ventura County. Alteration of land use there, from predominately agricultural to heavy industrial would constitute a considerable esthetic alteration and be nearly universally perceived as adverse. Visual clutter, noise and odors would result. Some air quality degradation would occur thus affecting areas many miles from the source. We have not obtained sufficient data to quantify air quality impacts from a modern refinery and so have not discussed that aspect as it relates to air clarity. Land use changes of this type are likely to spawn additional industrialization and be permanent in duration.

Abnormal or accidental events during the development stage would potentially include loss through sinking or stranding of platforms, storage equipment and vessels. The impacts would be visual in the form of wreckage which might not be salvaged and oil spillage. Loss of platforms is construed as some accident occurring while the structure is being towed from a dry dock construction site to an installation site. Leaks from pipelines may occur and some disruption of the beach or estuary will exist for several months after pipeline construction. Oil spill dangers from barges and well blowouts persist through this phase. These risks are considered as a composite of the whole program in the following section's discussion of production. Flaring which involves improper combustion will produce heavy particulates whose noticeable persistence will be on the order of a few hours following cessation of the activity.

Onshore untoward events could result in impacts such as landsliding at installations and spillage of noxious or toxic substances stored or utilized there. These events would be highly unpredictable and speculative, thus no quantification of impacts will be made.

Production is the main phase of this proposed program and will last for about 40 years for individual fields. Production will probably cease about 2020 for shallow water portions of this proposal and extend to 2040 for the deepwater areas.

Impact producing elements during normal operations will include permanent features like platforms, pipelines, treatment and storage facilities in the offshore. Periodic significant oil spills will occur from wells, pipeline breaks and barges. Low level spillage will be constantly present. Barges and work boats will add to congestion. Periodic transitory increases in turbidity will arise from mud lost or discarded during well workover and maintenance, and from sediment suspension in pipeline maintenance work. The presence of nearby platforms will infringe upon the solitude of the sea causing esthetic degredation for some.

Platforms will cause the longest lasting most prominent visual esthetic impact wherever they are installed. Visual impacts can be viewed in two ways: 1) impacts increase in magnitude when they occur in a totally natural environment or 2) impacts increase in magnitude when they are visible to greater numbers of people. Under these criteria, platforms on the Outer Banks would produce a greater impact in criterion 1 while they would produce a greater impact in Santa Monica and San Pedro Bays under criterion 2. Both criteria in combination are valid because we are analyzing these impacts in terms of the human environment, thus supporting criterion 2 where numbers become important, while simultaneously recognizing the value of an environment untrammelled by great numbers of men and unencumbered by his physical accouterments as is suggested in criterion 2.

Visibility plays an important role in the visual impact of platforms. The best visibilities occur in January but in most cases the January-July spread is only a few percentage points. Platforms will be visible according to the following table of visibilities.

Regional Visibilities by Percent of Occurrence

Location	% of observations with visibility exceeding 5 n. miles
Santa Monica	
January	88
July	87
San Pedro	
January	71
July	76
S. Catalina Isl.	
January	92
July	89
Dana Point	
January	93
July	84
Costa Mesa	
January	92
July	75
Santa Cruz Isl.	
January	94
July	91
	% of observations with visibility exceeding 7 n. miles
Pt. Mugu	
January	76
July	53

Some portion of a one hundred foot structure can be seen from the beach if it is located 17 miles or less from shore. From elevated vantage points it is often possible to see several of the offshore islands at a great distance. In the Santa Monica Mountains, Anacapa, Santa Cruz, Santa Barbara and Catalina Islands can be seen. In Orange County, Catalina and occasionally San Clemente Islands are visible. This means that all of the proposed tracts within Santa Monica and San Pedro Bays and Catalina-Santa Barbara Islands are visible from portions of the Los Angeles-Orange County coastal area during portions of the year. At distances of 20 miles and beyond, the size of platforms would appear very small. That in combination with haze would render the visual impact of platforms at those distances as nil.

If platforms are permitted in Santa Monica Bay, they will be visible much of the time from nearly all of the coastal viewpoints. They will be fairly prominent objects exhibiting discordant vertical and angular lines and contrasting tone against the soft flat plane of the sea. Those within ten miles of shore will be very prominent objects and be seen from at least two onshore directions. Nowhere will they be framed by a background of similar appearance. They will affect the view considerably.

In San Pedro Bay platforms will be viewed against an already industrialized cluttered skyline in the Los Angeles-Long Beach Harbor area. Viewed from the other direction, they may tend to be obscured by the presence of Catalina Island in the background. In Orange County, offshore wells exist in state waters as far south as Huntington Beach, thus platforms in federal waters would constitute much less of a contrast with existing conditions than they would in Santa Monica Bay.

South of Huntington Beach, the shoreline is less developed and not industrialized. From Huntington Beach south to the end of the proposed sale tracts near San Mateo Point, the visual impact is increased, approaching those conditions prevailing in Santa Monica Bay.

Approximately 85 million visitor days are expended annually at the coast of Ventura, Los Angeles and Orange Counties. If approximately 27 percent of those are engaged in sightseeing as a major activity, then 22,950,000 visitor days are going to be affected to some degree by esthetic alteration in Santa Monica and San Pedro Bays. Adjusting this figure for lowered visibility indicates an annual impact of more than 19,000,000 visitor days without adjustment for annual growth in use. The state predicts an increase in demand of 30% to 1980 and 32% from 1980 to 1990 measured in participation days for the affected portion of the coast.

In addition to beach users, who may originate locally or from distant points, there are numerous residents whose view will be affected by structures as often as visibility permits for the duration of the field's life. We cannot quantify this impact without knowing the number of viewers, the nature of their perception and intensity of their reaction to the change in their view. The number of those affected, without regard to the nature of their reaction will be extremely large when computed over the project's life.

Numerous users of the Coast Highway and ocean front streets will be affected by esthetic changes. Realizing that there is overlap between beach, residential and highway users, we estimate a large additional increment of impact for the driving public.

Santa Barbara-Catalina tracts may occasionally be visible from the mainland but platforms would appear very small and indistinct. Viewers on both of the involved islands and boaters would see platforms rather readily. The only population concentration on the islands is at Avalon on the far end of Catalina from these tracts. Large numbers of boaters use the waters around Catalina and many clubs maintain anchorages in coves on the island's north side. These people would be affected. Santa Barbara Island is part of the Channel Islands National Monument and receives visitation from private recreational boaters and commercial carriers. Total visitation to the monument averages about 42,000 which we will allocate evenly between Anacapa and Santa Barbara Islands. Due to the difficulty of access to the island, the casual recreationist is largely not present. We feel that most of the visitors are therefore primarily interested in the island's scenic and natural values and consequently susceptible to the visual impact of platforms and support vessels. There is pristine ocean around Santa Barbara, thus a large potential impact. No state oil sanctuary exists at Santa Barbara, thus no buffer in federal waters adjoins the state waters. Platforms could be erected within 3 miles of the island itself and less than 2 miles from the monument boundary. If this circumstance ensued, the visual character of the monument would be greatly altered. Approximately 20,860 visitor days annually would be affected with 940,300 visitor days affected for the life of the proposal. We have no estimate of the number of boaters passing through these tracts but it is likely that a significant percentage of Southern California boaters do use this area occasionally.

Santa Rosa-Cortes North tract area is exposed to few permanent residents. Its visual impact will be seen by boaters primarily. Many Santa Barbara area boaters use the waters surrounding the northern Channel Islands for weekend day use and overnight outings. The only viewers will be boaters and the residents of Johnson's Lee, a small military installation on the south side of Santa Rosa Island. Both the islands and the surrounding sea are nearly pristine and thus the potential impact is large. There is no federal buffer adjacent to state waters in this block, thus permitting platforms within 3 miles of the coast. The secondary impacts spawned by this situation are potentially greater than the results of this proposal's implementation. If drainage of hydrocarbons from state lands occurs due to federal lease development, then leasing may occur on adjacent state lands. This could result in platforms in close proximity to the islands including San Miguel which is the site of the most valuable pinniped rookeries in the Bight. Loss of this resource would constitute an esthetic degradation of large magnitude and permanent duration.

Santa Rosa-Cortes South tract blocks are far removed from any land based viewing position, lying a minimum distance of 15 miles south of San Nicolas Island. San Nicolas has a naval installation on it with few permanent residents. It is used by pinnipeds for hauling out and rookery purposes. Boaters would be the major viewers and most of them are there to fish or scuba dive. Industrialization of San Nicolas could affect the esthetic resource visually and through driving away the pinnipeds. Esthetic impacts would be lowest on these tracts when compared to the others proposed.

Normal operations will result in some floating debris being cast up on beaches. This will constitute an esthetic loss for those affected.

Esthetic values will be impacted by accidental events which are statistically bound to happen. These will occur during drilling, well operation, storage of production, transportation and maintenance. Fires, leaks and spills will result, with concomitant visual and biological effects.

Chronic spillage at low levels will continue throughout the life of the proposed action resulting in small slicks or tar balls visible to boaters and cast up on beaches. Natural sources of oil already contribute to this type of pollution and it may be difficult to separate the two. The existing situation will be somewhat exacerbated.

Noise from pumping stations and other operations will constitute an esthetic impact.

Fires will produce air quality reduction on a temporary basis and usually have associated oil spills.

Spills greater than 50 bbl from all sources will occur with spills in excess of 1,000 bbl being probable. These have the potential of affecting several million visitor days over the life of this proposal. Most effects are temporary in duration, although the lost opportunity is irretrievable. Permanent effects could ensue if certain biological resources were destroyed or if land use changes from natural conditions to industrial in conjunction with this proposed sale persisted after abandonment of the fields, as is likely.

During the final stage, abandonment, there is some risk of oil spill, but it is low. Removal of equipment will result in noise and increased traffic, temporarily. Placement of scrap equipment on land may cause an esthetic impact. Nothing should remain in federal offshore waters after abandonment, as Federal Regulations require total removal of equipment to below the mudline.

3. Historical or Archeological Sites and Objects

Impacts on historical or archeological resources could arise from both indirect and direct sources. Direct sources include oil spills and construction activities, while indirect sources include induced industrialization and land use changes.

California was the focal point for early exploration and settlement of the Pacific coast, which resulted in numerous historical and period architectural values being currently extant on land. Numerous prehistoric settlements existed which engaged in vigorous water-borne commerce and food gathering. Spanish ships were present as well as other European vessels and evidence exists that Asian vessels visited this coast prior to Spanish presence. It is certain, therefore, that vessels of archeological value as well as artifacts and sites on submerged lands exist. Federal agencies are required, by Executive Order 11593, to locate, identify, and nominate to the National Register of Historic Places, all cultural resources within their jurisdiction that meet the criteria for nomination. Presently, no such values are known to this Bureau, but procedures have been worked out involving the National Park Service in its role as technical advisor for such resources, the Geological Survey, and the Bureau of Land Management, whereby a satisfactory cultural resource reconnaisance survey procedure may be implemented to discover these resources prior to construction activity. Cultural values may thus be discovered and potentially added to the National Register. Several places listed on the National Register are near or within view of the coast but only two, Pt. Fermin Lighthouse and Cabrillo National Monument are at the coast. Neither of these places is directly involved with this proposal although alteration of the sea view by placement of oil related equipment would change the "character" of Pt. Fermin Lighthouse. California Historical Landmarks, as designated by the CHL Advisory Committee and the Director of the Department of Parks and Recreation, exist at several coastal locations. Those which may be affected by either visual alteration of the surroundings, or by the esthetic damage of an oil spill are: Timm's Point, San Pedro; Dana Point; Mc Fadden Wharf, Newport Beach; and Anaheim Landing, Seal Beach. In addition, there are several places in the San Diego area which run a remote risk of having oil cast up on the adjacent coast.

The greatest risk to historic places, structures and architectural examples, particularly those which have values but have not yet been designated on either the state or national registers, arises from induced industrialization and consequent land use change. Such change may directly affect the cultural value by razing or indirectly by radically changing the surroundings. Historic values often occur in old neighborhoods where commercialization and industrialization pressures tend to be highest. If industrialization occurs in Los Angeles, the effect would be less than if it occurred in lower population areas of the coast.

Archeological values could be damaged by oil contamination in two ways. Oil coating would depreciate their appearance and usefulness and may endanger their survival through cleaning operations. Carbon dating could be interfered with by contaminating the samples with crude oil.

Construction activities in the offshore area such as platform installation and pipeline burial could adversely impact archeological values through disturbance or destruction. Pre-construction surveys discover the majority of cultural values, but they are not infallible Older sites whose inhabitants did not use ferrous metals or which were constructed on unlikely topographic features or were subjected to sufficient sedimentation as to totally obscure any man-caused topographic features are particularly vulnerable to destruction.

The most favorable coastal terrain for pipeline landings coincides with that which is most favorable for discovery of archeological values. Quantification of impacts or determination of probability is not possible beyond the general observation that the more northerly landing a pipeline has, the greater is its probability of adversely affecting an archeological value, this is ascribable to the increasing density of Indian occupation from south to north. Similarly, far less impact is likely where pipelines come ashore in urban areas such as Santa Monica or San Pedro Bays where the original occupant density was lower and urbanization has already wrought disturbance and alteration.

The Channel Islands are a virtual storehouse of archeological and paleontological values both because they were extensively occupied and have been little exposed to human activity in the post-European discovery period. Any oil related activity on these islands has great adverse potential due to destruction by construction activities or by exposure to vandals and untrained collectors introduced as members of crews or their families.

Extensive mapping exists for coastal archeological values and adverse impacts could be partially mitigated through consultation with appropriate local archeological authorities prior to final route selection and coordination with them during construction activities which might disclose undiscovered values.

See Section IV.E.4.a. for a stipulation which will be applied to any lease resulting from this proposed sale for the protection of archeological, architectural, or historical values.

4. Sport Fishing and Recreational Boating

As indicated by Horn (1974b) sport and commercial fisheries catch essentially the same fishes. Therefore, most of what was said about commercial fish applies to sport fish as well. Emplacement of offshore petroleum structures will have both beneficial and deleterious effects. Structures are known to attract large numbers of fish. On the other hand, a portion of the potentially fishable population would probably be "eliminated" because they would not be accessible to conventional fishing gear. And, by concentrating fish populations at potential pollution sources, the potential losses from an oil spill are increased. Therefore, it is impossible to determine whether there will be an overall increased yield or not. For a description of the material in this section see Sections II.G.3.d. and II.E.4.

It is our opinion that a major oil spill would affect fishing adversely. Boat fishermen would not want to soil their boats by fishing in the vicinity of an oil slick and neither boat nor surf fishermen would want to keep fish that had been coated or contaminated with oil. Therefore, sport fishing would be curtailed in the vicinity and for the duration of the spill incident. This would not preclude fishing in alternate areas even though the catches there might be lower.

We have no data to confirm the adverse impact on surf, shoreline and private boat fishing, but according to the California Department of Fish and Game (1969) the number of fish taken from partyboats operating out of Santa Barbara very definitely declined during the blowout. During the 6-month period, February-July 1969, reported landings were only 10% the size of those for the previous four years for a comparable period and it is probably valid to estimate a similar decline for sport boats.

The major portion of this decline can unhesitatingly be attributed to lack of fishing effort. Because of the adverse publicity of the oil spill, sportsmen fished elsewhere. The total number of boat days during the six month period was only 13% of the average fishing effort for a comparable period during the previous four years. Only 723 sportfishermen used partyboat facilities at Santa Barbara during this period in 1969, while 5,693 used them in 1968. A comparison of sport catch to fishing effort during the six month period, reveals that the catch per fisherman day was 6.7 in 1969 compared to 8.9 in 1968. Catch data from 1965 indicate the catch per angler day fluctuates widely in the area, but was slightly lower than average on the Santa Barbara partyboats in 1969.

We have received extensive testimony and evidence that in the Gulf of Mexico, oil and gas operations have an overall favorable impact on sport fishing activities. The favorable impact is the result of sports fish population enhancement due to the artificial reef effect of offshore platforms. In the open sea, offshore platforms provide both food and cover in areas that are largely devoid of these essentials. Myriad forms of microorganisms in the water drift by these structures and attach themselves, soon encrusting all exposed surfaces on the platform. The average platform in 150 feet of water provides 90,000 square feet of hard surface for encrusting organisms. 1/ Hard substrate is necessary for encrusting organisms such as barnacles, corals, mussels, hydroids, and other invertebrate organisms which serve as links in the food chain. Randall (1963) has stated that artificial reefs provide

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1/ Information from Keith G. Hay, Conservation Director, American Petroleum Institute.

protection, food sources, spawning sites, and spatial orientation markers for fishes. The same author found that artificial reefs attract available fish from surrounding waters, and increase the size of some populations by providing additional protected areas and food for both young and adults.

Investigations conducted in Southern California have indicated artificial structures to be fish attractants (Horn, 1974a; See Section II.E.4). Kelp forests, in conjunction with adjacent rocky bottoms, provide a habitat somewhat similar to oil structures. Because this type of habitat is already present in Southern California, we believe the change in sport fishing habits and certain fish community structures will not be as pronounced as it was in the Gulf of Mexico.

As discussed under impacts on commercial fisheries, quantifying fisheries losses from a hypothetical spill can be extremely misleading (see Section III.E.). However, if the same hypothetical 500 square mile circular oil spill, discussed under commercial fisheries, were superimposed on the Bight's most productive sport fishing area, catch reductions of over 445,000 fish might result. (The median number of fish per block for 1971-1972 was used.) The same assumptions made for commercial fisheries were applied here. It should be stressed that the 445,000 fish lost only reflects fish taken from commercial party boats. There are large, but unquantifiable, numbers of fish taken from the 179,455 private boats/ships registered in the project area as well as those taken from beaches and piers.

Recreational boating will be affected by normal exploration, drilling and production as well as by catastrophic events such as blowouts.

Development construction and supply activities will result in increased traffic in harbor areas and sea lanes. This will produce traffic competition for recreational boating. Highway congestion in the vicinity of the harbors could increase to an indeterminant degree. This would create problems for boaters trying to reach the facility with their trailered boats or to reach their tied up craft. Increased demand for commercial harbor facilities may result in loss of slips and moorings for recreational boats or a reduction of boat sales under severe circumstances. However, harbor improvement could become feasible as a result of greater need.

Disruptions created in marinas and harbors, by supply boats and barges, would be less during the production phase than during the development stage. If pipelining is chosen to bring oil ashore, then impacts due to transportation will be minimal but if barging is chosen, then increased traffic and harbor congestion will continue to impact recreational boaters.

In offshore areas, platforms are mixed in their impacts. They may function both as navigation aids and as hazards. On occasion, platforms may serve as points of refuge for boaters overtaken by sudden storms or beset with mechanical or fuel problems. Sailboats may find them more of a problem than power craft, particularly if densely located.

Esthetically, many boaters may find platforms to be undesirable. Their lines (unless disguised as in the THUMS project near Long Beach) are discordant features on the flat plane of the sea and their presence constitutes a violation of the normal solitude which exists on the open sea.

In summary, the event of a catastrophic oil spill, some loss of recreation values can be expected wherever the slick intercepts a recreational boating use area. Boaters can be expected to avoid the area. However, if hapless enough to encounter it, their boats would probably be damaged by staining. Harbor closures as happened at Santa Barbara during the 1969 spill, will preclude people from using their boats. Small slicks from platforms or vessels associated with the oil industry will cause esthetic degradation.

5. Unique Biological Environments

There are two kinds of designated unique biological environments established by the state of California; Ecological Reserves and Refuges (controlled by the Department of Fish and Game) and Areas of Special Biological Significance (controlled by the Water Resources Control Board). (See Section II.F.5.). The ecological areas controlled by the Department of Fish and Game, except for Farnsworth Bank, are primarily to protect the aesthetics and biology of intertidal communities and the fishes associated with them (Smith and Johnson, 1972). The impacts on the biological communities involved are covered under their sections, leaving only aesthetics to be covered here. A major oil spill will interfere with the aesthetics of an intertidal area for as long as the oil covers the area.

As stated by the California Water Resources Control Board "Areas of Special Biological Significance (ASBS) are those areas containing biological communities of such extraordinary, even though unquantifiable, value that no acceptable risk of change in their environments as a result of man's activities can be entertained."

> Generally, the regional boards would prohibit the direct discharge of wastes into an ASBS or in the immediate vicinity. Discharges some distance away are required to have a monitoring program to demonstrate that the discharge could not be detected inside the ASBS. Wastes presently being discharged into ASBS are being phased out. Existing discharges which influence water quality in ASBS are either phased out or required to comply with requirements which prevent the detection of waste substances within ASBS. (California Water Resources Control Board, 1974).

The control does not apply to vessel wastes, the control of dredging, or the disposal of dredging spoil. The existence of communities of such high value that the discharge of any pollutants into the area is unacceptable, puts a responsibility on other potential polluters to follow the spirit of the law. Any pollution resulting from offshore oil activities which enters an intertidal area or near shore area designated as an ASBS would be unacceptable according to the intent of this law, and the State Water Resources Control Board has indicated that any discharges or other forms of detectable pollution resulting from OCS leasing which enter ASBS would fall under their jurisdiction. Even a small spill would greatly impact an ASBS if it went ashore because a form of pollution would involve an unacceptable risk in accordance with ASBS law.

The unique biological areas are described in Section II.F.5. and shown on Graphic 4. The ASBS include more areas than the Refuges/Reserves, but there is a definite overlap of the two kinds of designated areas. Areas critical to an oil spill impact include: (1) the Channel Islands, except part of the northeast side of Santa Catalina Island; (2) the mainland coast from Mugu Lagoon southeast to the northeast corner of Santa Monica Bay; (3) Newport Beach southward to Dana Point. Areas less critical, but in danger to the aesthetic impact from a major spill are the Point Fermin area on the Palos Verdes Peninsula and Anaheim Bay.

The following list of unique biological areas of Southern California indicates the type of ecosystem being protected by each area. The specific impacts on each ecosystem type are discussed in Section III.D.

Marine Refuges

Point Fermin (intertidal)
*Newport Beach (intertidal)
*Irvine Coast (intertidal)
Laguna Beach (intertidal)
S. Laguna Beach (intertidal)
Niguel (intertidal)
Dana Point (intertidal)
Doheny (intertidal)
*San Diego (intertidal)

Ecological Reserves

Farnsworth Bank (submarine bank)
Bolsa Chica (wetland)
*Heisler Park (intertidal)
Buena Vista Lagoon (marsh & lagoon)
*San Diego-La Jolla (intertidal)

ASBS

Channel Islands and Begg Rock (intertidal; Marine Mammal and Bird Areas)
Mugu Lagoon to Latigo Point (marsh)

* Indicates other ASBS.

J. Other Impacts

1. Induced Industrialization in the Coastal Zone

The activities resulting from the proposed sale would fall into the three main categories of summary exploratory drilling, development well drilling, and production operations. The urban impact of the above activities will generally be in the areas of government, population, and the coastal zone. Employment activities resulting from the proposal will utilize both persons within the existing Southern California labor market and persons moving into the area. It is estimated that the percent of new persons by operational phase will be:

Phase	Percent of Employees Not in Local Labor Force
Exploratory Drilling	85%
Development	35%
Production	20%

The employment figure will vary from one operational phase to another but the high figure will be approximately 9,000 persons for any one phase at a given time, thus representing 21,600 total persons including immediate family members, or a figure considerably less than one percent of the existing Los Angeles area population. At the peak production period, about 1987, the number of employees will rise to about 15,000 persons, or 36,000 including all family members. Again, this figure represents just a small percentage of the total population within the area. See Section III.J.2. for more details on employment. The induced employment figure of between 8,000-10,000 workers represents persons already living within the area and will not necessitate new persons moving into the existing urban areas.

a. Summary Exploratory Drilling

During the exploratory drilling phase the bulk of activities will occur offshore and will involve the least number of employees than will the other two phases. The major phase of the operations will be directed towards ocean vessel activities with a minor role occurring within the coastal zone and limited mainly to sales and services activities.

i. Population

In terms of the impact on the population, the result will be minimal. The number of workers involved in this phase will be approximately 1,500 of which 1,300 will move into the area, or about eighty-five percent of the total. The increase of persons from the outside, including family members, will total about 3,100 persons, or a small percent of population within the Los Angeles area. In terms of impact on housing, the following data indicates an ample supply of dwelling units already exists within the area. The housing vacancy rate by county are:

County	Single Family	2-4 Units	Multiple Family
Los Angeles	1.8%	4.6%	5.0%
Orange	1.0%	4.4%	3.5%
Ventura & Santa Barbara	1.5%	4.6%	3.3%

Source: Southern California Gas Company.

The total number of dwelling units in 1970 by county were:

County	Dwelling Units
Los Angeles	2,430,822
Orange	436,120
Ventura	106,469
Santa Barbara	83,929

Source: 1970 Census of Population.

The above data indicates that a sufficient supply of housing exists within the area. Some governmental services will be needed to serve those that move into the area, while those persons already living in the area will continue receiving services. The demand on government is not expected to be significant. The impact on local schools will not be great since school enrollment is down generally throughout the nation and school demand has steadily been decreasing over the past several years.

The impact on local traffic will be minimal since about 15 percent of the persons involved are already residing in the area and using the existing transportation network. Even if the bulk of new employees were moved in the area, the total usage for the employee and family would only increase the average daily traffic by about 12,000 trips or 7.7 trips per household.

The only possible impacts on the population would be visual and pollution. The increased number of vessel trips on the coastal area would disrupt the marine view for some while others may not find the traffic objectionable. In terms of pollution the added emissions from the vessels, equipment, and from related land vehicles would increase the levels of contaminants in the air. As pointed out in the section of impact on air and water quality, the impact will be minimal.

ii. Coastal Zone

The land based operations of the exploratory drilling phase will increase local traffic, add exhaust emissions into the air and will increase the noise level in proximity to the operational sites. No adverse impact will result from those operations.

The major phase of the impact will occur offshore in the areas of exploration and in the shipping lanes that will be used. The air pollution and oil spill data has been discussed elsewhere. No lasting impact is expected to result in the deterioration of the coastal zone with the activities of the summary exploratory phase. The added ship and helicopter traffic connected with the exploration phase will occur only during that phase and will not add significantly to the existing traffic. Existing air and port facilities are able to handle the increase in air and ship traffic.

iii. Government

During the summary exploratory operations phase it is anticipated that the impact on government and governmental sources will not be significant. The largest impact will result from increased vessel movements in the offshore waters which will add to the monitoring function of the United States Coast Guard. It is estimated that the volume of ship traffic will not be significant nor will the use of helicopters add substantial amount to the existing air traffic. Some existing police and fire services will be utilized to serve the onshore facilities.

b. Development Well Drilling

During this phase of operations major activities will occur both onshore and offshore and will involve substantially more employees than were needed during the first phase. The well drilling phase will occur over the next twenty-five years and will involve changing numbers of employees throughout the period. Initially only 1,800 will be used, will peak to about 9,000 in 1987, and will drop to 1,300 by the year 2,000. The increase of shore based activities will be as a result of increased manufacturing and construction of materials for use in the offshore program and for base, service, and logistic operations. The need for goods and resources will result in spin-off benefits which will result in employment generation in other labor groups of the economic sector, thus increasing the labor ranks in those areas.

i. Population

In this phase of operation, the bulk of the employees will come from within the ranks of the existing labor force, particularly from those living within the Los Angeles area. Only about one-third of those employed will come in from other distant geographical areas. The number involved during the peak period of employment will be about 21,600 persons including family members. The number represents less than one percent of the existing local population and will not result in much of an impact since two out of every three persons will already be living in the area. In terms of housing needs for those moving into the area, the demand could be met without any undue difficulty. Some government services will be needed to serve those moving into the area, but the majority will already be local residents receiving all necessary services. The services impact will be minimum and will be directed mainly to local government including school districts.

The impact on local traffic will be minimal since many of the persons involved are presently in the area and using the existing transportation network. Even if the bulk of the new employees were to be moved into the area the total usage for the employee and family would increase the average daily traffic only by about 65,000 trips total or less than one-tenth of one percent of the existing traffic. The pattern of traffic flow would change by the increased number of trips towards the ocean area during morning work peak hours and in the opposite direction in the afternoon. The expanded traffic volume will increase traffic flows in the shore area and will result in the possibility of raising the number of accidents on public streets by less than one percent.

The increased effort of this phase will result in more visible traffic and other activities on the ocean and on the shore. The flow of work vessels and supporting helicopters in addition to platform construction will disrupt the ocean view for some.

ii. Coastal Zone

The land bases operations of the development well drilling phase of the program will increase local traffic by less than one percent, add exhaust emission of insignificant amounts into the air, and slightly increase the possibility of vehicle accidents. The construction of materials for offshore use may cause noise, odor, dust, and vibration conflicts with other land uses, but since the activities must be located within an appropriate land use zone the conflicts will be tolerable.

It is estimated that between 100-200 acres in 2-5 acre plots of land will be needed for this phase of the operation, and will be located in the vicinity of the ports in Los Angeles and Long Beach. Both port authorities are in the planning stages in order to prepare for the offshore activities, and both indicate that ample facilities and space will be available.

A nuisance impact will last for a short period during the construction of onshore pipelines. Since the oil will be piped to the Los Angeles area refineries it is questionable as to whether or not the existing connecting pipelines will be adequate to handle any increase. If not, then additional pipelines will need to be constructed for about one hundred miles in the same corridors. During the trenching operation heavy equipment will be present, thus adding to the noise, sight, dust and pollution and vibration problem. In addition, there is always the possibility of fuel spills which could damage vegetation in the immediate vicinity. The earth removed in the operations will be replaced and vegetation replanted at the construction sites. The above impacts are short-term and lasting for the construction period. The establishment of permanent pipeline rights of way will occur which will establish a long-term development barrier by prohibiting future building. The openess of the area of the right of way will have a long-term impact.

Note 1

Estimates for onshore storage needs for the life of the project are:

Years	Barrels	Acre Needs
1979-1989	2,570,000	20.5
1990-2000	4,160,000	33.2
2001-2010	4,690,000	37.4
2011-2020	3,030,000	24.2
2021-2046	1,400,000	11.2

The estimates are based on an average of a five day's storage time. If the storage time is less, then the storage requirements will also be less.

The construction of onshore treating and storage facilities will have both short-term and long-term impacts on the coastal zone. The short-term effects are similar to those associated with the pipeline operations and are only found during the construction phase. These impacts come from blasting, trenching, vehicle emission, earth removal, and result in short-term disruption of the terrain, vegetation, and wildlife. There are also the temporary presence of noise, odor, sight, and vibration conflicts. The long-term effects include topography change and land use change. Since local grading ordinances and zoning ordinances will apply during the construction phase the work must be according to local standards which will result in a minimal impact.

The presence of land use planning operations will affect the construction activities for both the treating and storage facilites and for any proposed refinery location. Since the California Coastal Zone Conservation Commission has developed a preliminary shoreline plan, a high degree of coordination must be established with local governments in the siting of such facilities. The coastal plan does not rule out oil related needs, but does stress the importance of proper location and adequate protection regulation in order to preserve the coastal resource.

Since there is a tie between land use zoning and the comprehensive plan it is anticipated that the location of oil related facilities will be in a proper and acceptable zone. This fact will minimize conflicts in that similar type uses will be located in the same vicinity and zone, thereby eliminating use and activity type conflicts.

The planning operations of local governments may be affected by the possibility of oil facilities being located within their jurisdiction. Depending on public opinion, the planning activities may have to be altered to the extent that such uses are either attracted or discouraged. Thus, the local planning activities will be affected by the proposal.

Due to increased demand, but not as a direct result of this sale, it is possible that one additional refinery will be needed which could require eight hundred acres of land. However, there will be a need for three onshore oil terminals, and one gas onshore terminal in addition to the onshore storage requirements. The oil and gas terminals will occupy two hundred acres. In all probability these facilities will be constructed in the Oxnard area in Ventura County. With the oil production currently in the Santa Barbara Channel area, these facilities can be justified at this point of time.

Because of the intent of the California Coastal Zone Conservation Commission preliminary plan, the facilities will need to be sited after consultation with local governments and meet all applicable regulations. Since Ventura County is an agricultural county, the two hundred acres needed for the development will probably be taken from the existing farmlands in the area.

The impact of the removal of two hundred acres in farmland will result in the annual loss of $556,816 in crop revenues based on 1973 production receipts. In addition, those lands are currently contributing property taxes as follows:

Area	Taxes*
Unincorporated areas	$ 27,527
City of Ventura	$ 29,810
City of Oxnard	$ 29,287

*Depending on which jurisdiction the 200 acres might be located in.

The removal of two hundred acres of agricultural lands from the tax rolls will more than be offset by the increased taxes generated from a higher land use category. Based on current land values of lands in petroleum related uses and general industrial uses, the following taxes can reasonably be expected to be generated by the new facilities based on where they are located.

Area	Petroleum Facility Use	General Industry Use
Unincorporated areas	$373,893	$240,490
City of Ventura	$404,895	$260,431
City of Oxnard	$397,799	$256,028

The tax figures are based on the market value of ninety one acres of refinery lands in Ventura County having a market value of $74,704 per acre, and 2,674 acres of industrial lands with a value of $48,050 per acre. A tax rate per $100 of assessed value based on average locations was used as follows:

Area	Rate
Unincorporated areas	$10.01
City of Ventura	$10.84
City of Oxnard	$10.65

iii. Government

During the production operations phase of the offshore operation the impact on government and governmental services will be greater than found during the exploration phase. The ship and barge traffic increase will add to the monitoring function of the United States Coast Guard, but will only be a short-term impact. During the operational phase the bulk of the ship and barge traffic will have ended. The added increase on governmental service will be found in the added demands for police and fire protection, building inspections, zoning interpretation, use permits, Coastal Commission and air pollution control district approval, and in traffic control.

Since the majority of the labor force will be recruited locally, no new school demands will arise since the families already reside in the metropolitan area. The families of workers moving into the area will be serviced by the existing schools and will add an insignificant number of new students to the system.

c. Production Operations

During the production operations phase the bulk of activities will shift from the ocean to the land. Operation and maintenance crews will be on the platforms and the number of workers will be substantially less than those involved during the development well drilling phase. In addition, many of the future wells may have subsea completions and could function without permanent work force.

The onland operations will cover the shore to land transportation of gas and oil, refining and storage operations, and transportation of the product. In addition, modifications may have to be made to the existing refineries in order to increase production in addition to the new refinery.

Population

The number of employees required for the operation phase at the peak period should be slightly less than that necessary during the development phase. The number of workers then should be approximately 8,000 by the year 2000 and should drop considerably by the year 2040. It should be indicated, however, that the three phases associated with an offshore program do overlap, thus resulting in more workers than found in the dominant phase at the time. The maximum number of employers on the job at any given time should never exceed more than 15,000 persons at the peak year of 1987. The impact on government resources or transportation systems will not be significant.

Coastal Zone

The traffic, both highway and offshore, will decrease from that of the development well drilling phase. The operations will be more routine in that the resource will be moved from the offshore location to the onshore locations by 900 miles of pipelines (high case).

In general, the location of refineries have largely been conditioned by the source of the crude, the size, location and disposition of the market, and the availability and costs of the various modes of transportation. In the past this has resulted in locating most refineries around Los Angeles at or near coastal waters. Inland refineries are few and relatively small. The most obvious impact refineries will have on the coastal zones will mostly be with the air emissions produced. For example, petroleum refining produces emissions of nitrogen oxides, olefins (or reactive hydrocarbons), hydrogen sulfide and particulate matter. Although these emissions can be reduced, there is no known technological improvement that will eliminate them (Corps of Engineers, 1973). Catalytic cracking refineries produce more olefins than do hydrocracking refineries. Olefin emissions are reduced by the use of a CO boiler between the cracker and the exhaust stack. See Section III.F. for the impact on air quality and water quality.

The lack of space does not constitute an absolute limit on the expansion of refinery capacity, since an increase can be realized by replacing obsolete units with more efficient units. The expansion potential in the Los Angeles basin is limited, according to the Corps of Engineers. There is virtually no vacant land at El Segundo, however, a large increase in capacity is planned by replacing obsolete facilities. There is expansion space at the two refineries in Santa Fe Springs. There is also space for expansion at other refineries in the basin, but as reported by the Corps of Engineers, not enough to make a significant difference in capacity unless the currently used land is redeveloped more intensively.

A major new refinery utilized between 200 and 1,000 acres of land for a design capacity of 100,000 barrels per day (Corps of Engineers, 1973). For a design capacity of 200,000 barrels per day, the area requirements are between 500 and 1,700 acres. The Corps of Engineers reported in 1973 that there is a shortage of sites for new petroleum related facilities within the Los Angeles basin, therefore the potential Ventura County site becomes more important.

Government

The government sector will be impacted during the operational phase of the proposed project. The method of measuring the impact is with data derived from a cost/revenue analysis. The analysis is intended to outline the costs for services provided by government as opposed to income received in the form of property taxes and fees from the property receiving such services. In terms of revenue requirements for services received from government, industrial uses generate more tax income than is required to offset their demands. Oil related facilities are classified as industrial uses in local governmental control ordinances and are part of the group that produces positive property taxes within a community.

Two articles dealing with cost/revenue analysis on local government, or the cost of services as offset from ad valorum tax revenues, indicate that industry does generate a surplus of revenues for a local government (National Tax Journal, 1963).

A recent study by the California Builders Council (1973) substantiates through case studies in California that an industrial development will generate more income through taxes than what it costs to provide municipal services. The fiscal data projected from 1973 to 1982 indicated a composite surplus of $2,779,312 or a composite surplus discounted at 5.5 percent of $2,038,315. The bulk of the surplus is a result of school taxes in which no operating or capital costs were involved. The municipal government realized a surplus of funds in that no capital costs were required after the third year and also that the annual operating costs were less than the amount indicated under municipal revenues.

A recent study (Development Research Associates, 1970) for the City of El Segundo, California is important in that it presents cost/revenue data in a refinery centered town. The data in Table III-30 provides an estimate of municipal relationships, or a cost/revenue analysis for the 1970-1971 fiscal year. The data indicates that $2,944,000 were generated as industrial revenues with an accompanying cost of services of $2,084,000 or a surplus of $860,000.

Table III-30
ESTIMATE OF MUNICIPAL FINANCE RELATIONSHIPS
1970-1971 FISCAL YEAR

	Residential			Commercial and Industrial				
	Single Family	Multiple and Other	Total	Commercial	Industrial[a]	Total	All Other	Grand Total[b]
Base Factors								
Number of Persons	11,365	5,926	17,301	--	--	--	--	17,301
Number of Units	3,196	2,290	5,486	--	--	--	--	5,486
Number of Acres	448	85	533	61	1,737	1,798	1,171	3,501
Costs of Service								
Per Capita	$ 120	$ 120	$ 120	--	--	--	--	--
Per Acre	--	--	--	$ 1,200	$ 1,200	$ 1,200	--	--
Total Costs ($000's)	1,364	711	2,075	73	2,084	2,157	$ 298	$ 4,530[b]
Revenue - Sales Tax								
Per Capita[c]	$ 3.80	$ 3.80	$ 3.80	--	--	--	--	--
Revenue - Total Sales Taxes	43	23	66	204	650	854		920
Property Taxes[d]								
Total Assessed Value ($000's)	$23,000[e]	$7,000[f]	$30,000	$25,000	$175,000	$200,000	$24,000[g]	$254,000
Property Taxes[d] ($000's)	190	58	248	206	1,444	1,650	198	2,096
Revenue - Regular Subventions								
Per Capita	$ 15	$ 15	$ 15	--	--	--	--	--
Total Subventions	170	89	259	--	--	--	--	$ 259
Revenue - Other Total	$ 80	$ 41	$ 121	$ 284	$ 850	$ 1,134[h]	--	$ 1,255
Total Revenue ($000's)	483	$ 211	$ 694	694	2,944	3,638	$ 198	4,530[i]
Net Revenue or (cost) ($000's)	(881)	(500)	(1,381)	621	860	1,481	(100)	--
Per Acre	(1,967)	(5,882)	(2 591)	10,180	495	824	(85)	--

[a] Includes manufacturing, wholesaling, refinery, and utilities.

[b] Based on 1970-1971 levels, excluding separately covered Water Department costs.

[c] Based on local resident purchases at local stores only.

[d] At current rate of $0.825 per $100 assessed valuation.

[e] Based on $7,500 per unit plus personal property.

[f] Based on $3,000 per unit plus personal property.

[g] Includes vacant land privately owned.

[h] Assumed approximately three-fourths industrial and balance commercial based on detailed review of accounts.

[i] Assumed to equal costs.

Source: Development Research Associates

The establishment of additional oil facilities will not have a negative financial impact on the operation of local government. Studies have shown that industrial enterprises more than offset the cost of services needs by the amount of taxes generated.

Any impact on land use will depend on the development plans of the individual oil company. If plant expansion is opted rather than construction of new facilities, then the impact will be acceptable since existing facilities are already within areas zoned for heavy industrial uses. If any refineries are in zones other than those which specifically permit refinery use, then the legal non-conforming restriction for expansion will apply, thus disallowing plant enlargement.

If new sites are desired for plant construction, several problems arise. First there appears to be a shortage of vacant usable lands close to the coast which are zoned for heavy industry. The only compatable areas are those within proximity of existing refineries, but there is not ample room for new refineries. Second, the environmental control regulation for such development must be satisifed before development can commence. The California Coastal Zone Commission must approve all development within one thousand yards inland from the coast, and must designate such use as allowable within five miles inland of the coast. The Air Pollution Control District must also approve the development and determine that adequate attention has been given towards maintaining the air quality. The development must also be in harmony with existing control ordinances such as zoning, performance standards, and conditional use permits. It appears that the land use impact on local government is entirely dependent on the decisions of the individual oil companies. If expansion of existing facilities is opted, then the impact will be allowable since the existing facilities are located within the proper land use zone. It is not possible at this time to determine accurately the land use impact of the operational phase of the proposed offshore project in the absence of location and site plans.

The impact on other public and quasi-public facilities will also be minimal. It is not anticipated that more hospitals, parks, churches, etc. will need to be developed because of the proposed offshore activities.

d. Urban Recreation Impact

The effects of the activities of the proposed sale are covered in detail in the previous section on recreational, historical and archeological, aesthetic and conservation resources. The following is not intended to repeat what has already been discussed, but rather just to explain the impact of the proposed sale on urban recreation. The following information will identify the short range and long range impact on the recreational scene covered during the summary exploratory drilling, development well drilling, and production operation phases.

Summary Exploratory Drilling

During the first phase of the project the negative impact on recreation will be short term and disruptive in nature. With the added number of vessels in the area performing exploratory and investigative activities some sportsfishing and pleasure crafts activities may be inconvenienced during the phase. The sportsfishing activities may be disturbed by the sonar pinging effects on the fish population. All the activities are minor in impact and will not cause damage or have a long term affect on the recreational activities within the area.

Development Well Drilling

During the development well drilling operation many of the impacts noted above will still be present on a short term basis and will be more disruptive in nature rather than damaging. The impact on recreation will be noticeable during this phase but can be classified as short term. In beach areas where pipeline construction or other construction is occurring, several problems can arise. First, there may be an esthetic conflict resulting on beaches being less attractive to users. Also, a quantitative drop in beach attendance may occur because of the visual problem or the conflicts associated with construction activities in general. This will result in a qualitative drop on other beaches or recreational facilities due to over-crowding. When the beach becomes less attractive for use, then potential users will go to other beaches or to inland facilites to recreate during the disturbance period. Once the construction project is over, then people will probably return to the particular beach of their preference.

The sportsfishing and swimming conditions may also be disrupted during this phase. The activities may increase the turbidity of the water in certain areas, thus causing a temporary movement of fish to cleaner waters, or making swimming undesirable. The condition will return to normal with no lasting impact. The increased movement of vessels and the placement of structures in the water may be disruptive to sportsfishing boats and to navigation.

The possibility of a spill or well blowout during this time would certainly have an impact on urban recreation uses in the area. It is not possible to estimate the probability of occurrence or the magnitude of impact upon the recreation uses. Data on the subject is dicussed elsewhere in the statement.

Production Operations

During this phase of operation both positive and negative impacts will affect the urban recreation. Since no development plans have been drafted at this time it is impossible to assess any impacts in other than general terms, but the broad approach is indicative of future conditions.

Any subsea completions will reduce the visual conflicts which may have existed under the development well drilling phase. Using subsea completions, most mechanical devices are located on the ocean floor thereby reducing above water facilities. The sea view from shore would not be impacted in areas having subsea completions as severely as would occur if conventional platforms were used.

In ocean areas where platforms have located there is an increase in fishing possibilities. The presence of such structure creates a new habitat for fishes and attracts them to the area. Sportsfishing activities will receive a positive impact from the placement of such structures in the ocean.

During this phase the possibility of a spill, pipeline rupture, or well blowout is present. The negative impact from any occurrence will be dependent on magnitude, scale, and local conditions at the time.

2. Economic Effects

Prior to actual exploratory drilling and development, the total economic effects of development of the Federal OCS can only be postulated. In the following analysis primary as well as induced secondary or tertiary impacts are considered. Those that either may cause, or stimulate significant changes on social or economic activity are discussed in detail. This section is described in Section II.I.

There are three separate economic impacts to consider: (1) lease payments, (2) construction of capital equipment and pipelines, and (3) actual production of crude oil and natural gas in the area.

The initial revenue generated from leasing the proposed area would be in the form of lease payments to owners of the property. For this offshore production, all revenues received from lease payments will go directly to the Federal government. As such, these payments would have little direct impact on the California economy, but if development follows there would be induced or secondary impacts as a result of payroll taxes, sales tax, etc.

The second type of impact would be that resulting from construction of drilling platforms, production facilities and pipelines. Some estimates are available in this area and others will be generated to determine socio-economic impacts.

The third type of impact would be the effect that the produced oil and gas would have on the California economy in terms of increased availability and induced effects on onshore construction, etc., such as refineries and processing plants.

The amount of activity will be dependent on several factors such as the amount of the resource and time frame for development. Estimates as to the amount of net recoverable resource within the proposed sale area vary from a low of 1.6 to a high of 14 billion barrels of oil, and from a low of 2.4 to a high of 28 trillion cubic feet of gas. Estimates as to the number of platforms vary from 14 to 60 for both primary and contingency areas. A general impression of how much oil may be produced daily can be obtained by dividing the estimate of recoverable reserves by 40 years (the estimated life of the field). This gives an estimated daily mean production of between 110,000 and 960,000 barrels per day. Given the typical field production profile, production is greater during the first 10 to 15 years after development and declines steadily after all fields have passed peak production. Current OCS production in California (1974) is approximately 231,000 barrels per day of which approximately 46,000 barrels is from Federal waters in the Santa Barbara Channel. There are five platforms in the California Federal OCS and nine more in state waters.

In attempting to arrive at the total economic effect, certain assumptions must be made. These are:

1. The number of areas to be developed.
2. Projected platforms needed.
3. Timetable for development.
4. Number of employees.
5. Capital investment.
6. Support facilities required.
7. Services and purchases.
8. Gas production in relationship to oil.

This should be further broken down into exploratory and development well drilling costs, and finally the costs involved in production operations. Tentative projection of these costs can be ascertained. A model study, completed with the cooperation of the major petroleum companies, would have to be used in an attempt to pinpoint these costs with greater accuracy.

We postulate the following for our model study:

1. Development of five areas:
   (1) San Pedro Bay
   (2) Santa Monica shelf and basin
   (3) Santa Barbara/Santa Catalina area
   (4) Santa Rosa Cortes area north
   (5) Santa Rosa Cortes area south (Tanner Cortes banks)

2. Average mean production of 16,000 barrels per day per platform for a high case development down to 3000 BPD for a low case. Platform costs vary from 8 to 25 million depending on water depths.

3. Average daily mean production of 110,000 barrels per day (BPD) to 960,000 BPD of crude petroleum based on industry and U.S.G.S. estimates.

4. The maximum number of platforms that would be needed in the event of high case development would be 60. The low is estimated at 14. Subsea production systems and floating processors may be used in water depths over 1200 feet.

5. That pipelines be the major carrier of production although other alternatives will be considered. (Barging may be used for small quantities during early exploration and development stages but the quantity of crude would be small). Crude may be tankered in from extreme outlying areas if pipelines are not considered feasible due to water depth and subsea terrain.

6. Most production will be brought to the Los Angeles area for refining and may replace foreign crude. Early production is expected to come on stream in early 1978. Production is estimated at less than 50,000 BPD and up to 100 million cubic feet of gas.

7. Exploratory drilling may take up to five years and development drilling and construction an additional six to 15 years to develop each area (shallow vs. deep water).

8. A gas-oil ratio of up to 2,000 cubic feet of gas per barrel of oil is estimated for the OCS petroleum deposits, based on extension of Los Angeles basin historic data. This means an average of 2,000 cubic feet of natural gas probably will be

> produced for each barrel of oil extracted. Some hydrocarbon zones could be predominantly gas. This figure will be used in the study to determine the amounts of gas produced with oil to arrive at projected revenues generated.

On the basis of a wide range of estimated recoverable reserves in the sale area the following scenario has been developed. This was considered necessary in order to depict what economic impacts could be expected from the low to highest range. Much of the following narrative will be directed to a high case impact which is the most pertinent, but low and medium cases will also be discussed for comparison. In the following tables case 1 depicts a mean production of 100,000 BPD (40 years). Each following case represents an additional 100,000 BPD mean production.

Time Table and Postulated Development Plan

The exploratory drilling phase is expected to start immediately if a sale takes place providing drilling vessels are available. This would continue for a period of five years to establish the existence of economically recoverable oil and gas. Total employment is assumed at the same level in all cases (Table III-32). An estimated 12 drill ships would be required to explore the area during this five year period and an average workload of 8 exploratory wells is estimated per ship per year (Table III-33). In the event of a limited number of discoveries during this period some drill rigs may be moved to the development phase. Personnel required during this phase would be those on the drill ships, support boats and general support personnel.

When discoveries are made the development phase would start up with the possible addition of other drill vessels. Early exploration would be expected to begin in the Santa Monica and San Pedro Bay areas where an estimated 30 to 60% of the recoverable resource (oil and gas) lies. Also a large percentage of the area is in platform depths (under 800 feet) and production could be underway in 2 to 3 years.

The Santa Rosa Cortes area (north) is expected to be next in line for development. The final stage of development would be expected to take place in the Santa Barbara/Santa Catalina area and lastly the Tanner/Cortes banks which is the furthest area from shore. These last two areas are estimated to be rich in oil deposits but approximately 75 percent of the area is in very deep water.

Table III-31 postulates a possible development plan which depicts heavy development activity in the early stages in shallow water depths. Exploratory drilling in the sale area would cease in 1980 and the same personnel and drill ships would now be employed in the developing proven tracts. Additional drill ships and support boats would be added as well as increased support personnel. Construction labor during this period would be responsible for more than 60 percent of the total labor requirement. These crews would be involved in the construction of platforms, pipelines, pipeline terminals, floating structures, etc. During this period the drilling of wells from petroleum platforms is expected. Platform construction is assumed at 2 per year. In the event of maximum OCS development (case 10, 1 million BPD) the final platform would be completed in the year 2008. As the result of development priorities shallow areas are expected to arrive at peak production between 1985 and 1990 (Table III-20). As a result of delayed development deep water tracts would be expected to peak 20 years later. Peak production for a case 10 development would be estimated at 700,000 BPD when shallow water areas peak to

1 million BPD when deep water tracts peak. Production activity is expected to continue until 2040-2045.

Transportation

The physical difference between oil and gas is a factor in the transportation of deep-water oil and gas. The oil can be readily stored at or near the production area and readily transported in sea-going vessels. Gas cannot be stored or transported in sea-going vessels unless it is first converted to a liquid form, at a large cost in thermal energy loss and capital. This physical difference between oil and gas leads to a set of possibilities:

--- Oil production in relatively shallow waters will probably be pipelined to shore.

--- In deep water oil production may be pipelined to shore or shipped in tankers, depending upon the economics of each system and advances in pipeline technology.

--- Natural gas production in relatively shallow waters will probably be pipelined to shore.

--- In deeper waters natural gas production may be sent to shore in pipelines, reinjected, or collected in floating vessels for liquefaction at the production site depending on the economics of each system and the technology of natural gas transmission systems.

The flow from the projected production wells will consist primarily of oil, gas and water. These must first be separated at or near the production area and the separated gas must be treated for the removal of moisture.

There are currently 61.5 miles of pipeline leading from Federal OCS leases to onshore sites in the Santa Barbara Channel area. Thirty-two miles of this line is under State waters and the remaining 29.5 miles is in Federal waters. These existing lines are 4, 6, 10 and 12 inches in diameter. Larger diameter pipe may be used to avoid a multiplicity of lines. It is estimated that a maximum of 900 miles of additional pipelines will be required for both shallow and deep water transportation in the event of a high case development. In addition, oil lighters and LNG carriers will be needed to transport deep water production if pipelines are not considered feasible due to extreme water depth (1800 feet plus) and unfavorable subsea terrain. In this case the separated gas could be dehydrated and processed by liquification modules at the production area and shipped to shore by LNG carriers.

Onshore Facilities

The placement of treatment facilities (assumed here as the basis of impact assessment) will be to carry out all separations close to the wellhead in the petroleum production area. The primary rationale for this approach will be to remove the treatment activity from the coastal zone. In the vicinity of localities where petroleum processing facilities already exist, it may be reasonable to complete some of the treatment onshore. Additionally, the Los Angeles-Long Beach Harbor area contains widespread petroleum installations. Prior to the time field facilities were operational, temporary treatment of petroleum could be accomplished there at the opening of a field area with little incremental impact.

It is estimated that new refinery construction will be needed but this will be in response to consumer demand rather than to new supplies which may flow from offshore gas and oil fields. As stated in "Energy in California, January 1973", (The Resources Agency, State of California), "Regardless of where we obtain our oil, it still has to be refined to be of use. To process our 1985 demand, California's refining capacity of about 1.7 million barrels per day will have to be increased by about 70 percent."

Current forecasts of consumer demand indicate that refinery capacity in California will have to be increased by 30 to 55 percent between 1975-1985. This is based on a 2.5 to 4.5 percent annual demand growth increase for refined products.

It is anticipated that onshore acreage will be needed for storage and gas treatment. An estimated 100 to 200 acres could be utilized for these purposes. Additional acreage will be required for pipeline corroidors to come ashore. Acreage requirements for this purpose are small and land use imports should be minor. The previous section (III.J.1.) "Induced Industrialization in the Coastal Zone" covers both short and long term impacts as a result of increased industrialization onshore.

Population and Employment

The majority of workers engaged in OCS activities are expected to live in the greater Los Angeles area, where most of the activity will be generated. The second greatest area of activity would probably be Orange County, although the total influx here would be minor compared to Los Angeles. Some influx of workers and their families would also be expected in Ventura and Santa Barbara Counties as a result of projected activity south of the Channel Islands. The following discussion will analyze estimated population and employment increases as a result of OCS activity in relation to projected increases for the area. A discussion of the ratio to total population or employment would be too insignificant to be of meaning.

As illustrated in Table III-31 the total number of employees between 1975 and 1980 would be expected to peak at a total of 3,700 (case 10). This could be as low as 1,900[1] in the event of a case 1 development. Baseline projections for the five Southern California coastal counties (see Appendix 15) estimate a population increase over the next five years (1975-1980) of 625,000 for the area. Some of the employees would be expected to presently reside in the area but there would also be a shift of drill ship personnel to Southern California from the Gulf States and elsewhere. If we assume for this study that they were all new to the area and further assume a 2.4 family size, we are reflecting less than a 1.5 percent increase over the projection. This is further assuming that the new employees are in addition to the estimated population growth rather than part of it.

Between 1980-1985 the number of employees required is expected to more than double as a result of heavy exploration activity and the starting up of the production phase. As mentioned earlier this will be a period of heavy construction and construction employment will make up approximately 60 percent of the total work force. Most of the requirement will be for skilled labor. A large number of these employees are estimated to presently reside in the Los Angeles County area. In the event they were all new to the area, the increase over the anticipated increase (assuming the baseline is correct) would be 1.6 percent for workers and families. As a percent of the total population they would represent an infinitesimal amount (0.18 percent). As we can see the impact here would be negligible for a high case of activity. It would of course be even less for a lower case.

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[1] The figure 1,900 was arrived at by multiplying the number of case 1 employees (in each phase) in Table III-32 by average activity percents in Table III-31.

Between 1985-1990 this case study projects OCS related employment to be at its highest peak (Table III-31). Peak production is expected to be reached during this period from shallow water activities and the construction and development phase will be moving out to deeper water. As indicated an additional number of support personnel would be required as well as a large number of permanent personnel who will be engaged in production activities. Peak employment can vary of course in regards to total numbers, depending on the magnitude of the development and recovery (case 1 = 3,000, case 5 = 8,000, case 10 = 15,000). Assuming a mean development of 1 million BPD (case 10) operation there would be approximately 15,000 employees on the job. This would be an increase of 6,200 employees from the previous five year period. Assuming again that these are all new employees to the area (extremely hypothetical as many will reside in the area) the total increase over projected would be 1.8 percent. During this period there would be some transition from temporary to permanent personnel (development phase vs. production) which is reflected in Table III-31. If we further assume that 1/2 of this number moved to Los Angeles County with their families (factor of 2.4) the increment over the expected increase would be slightly more than 3 percent. As a percent of the total population in Los Angeles County they would represent one-tenth of one percent.

From 1990 until the operations halt completely there would be a gradual decline in employment. Development activities will cease after 2005 and production activities will decline in shallow water areas. Employees will then be shifted to the deep water production phase and development crews will move out to other areas (unless there are other sales). The down shift here will be considerably less than the upturn in employment during the previous five year period. After the year 2005 almost the whole of the total employee count will be permanent personnel. For many of these employees it will be a toss up as to who lasts the longest--them or the oil fields. The transition will be light.

There will of course be induced employment on shore especially in the service industry as a result of OCS development. Induced employment would be light for the development and exploration stages and somewhat heavier for a primary industry such as the production stage. A factor of .6 applied to peak employment (15,000) would be considered high but will be used for illustrative purposes. At a high point this would provide 9,000 new jobs in the south coastal area. These positions would be expected to be filled by people already living in the area. It would create additional dollar flow and help alleviate unemployment which is currently one-third higher than the national average (November, 1974). Many of these positions could also be filled by unskilled labor (gas station attendants, etc.). There would also be induced employment in many other areas nationwide for specialized tools and machinery, platforms, rigs, etc. There will also be a requirement for boats and marine equipment which could be constructed in San Diego.

Revenue and Dollar Flow

Total revenue from the sale of OCS produced oil and gas could vary from $11.2 to $146.8 billion over the productive life of the proposed sale area. This is based on current estimates of $10 a barrel for oil and $.60 per thousand cubic feet of gas. Assuming a high case development, capital expenditures flowing into the economy would be over $17 billion (Table III-33)expended over the next 30 years. Total revenue to the federal government, state and local government would be estimated at 35% of total revenue. In the event of the high case development, revenue generated for state and local taxes is estimated at $1 billion.

Income from primary employment is estimated at $25 billion[1]. Using a conservative multiplier of 2.5, this yields $87 billion of economic activity.

Imported Oil

Currently crude petroleum from foreign sources sells for approximately $11.50 per barrel compared to a $10 domestic price. Also regasified foreign LNG at a cost of $2 per thousand cubic feet is at least three times the price of domestic gas. On the basis of this factor alone it is more economically feasible to utilize domestic supplies.

Increased Petroleum Supply

This is discussed in the next section under "Oil and Gas Supply and Demand."

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[1] Estimated dollar flow for other base cases can generally be extrapolated by applying the percent of the base case total employment of base case 10 to income.

Table III-31

Case 1-10
SUMMARY OF ACTIVITY BY TIME FRAME FOR EMPLOYEES IN EACH WORK PHASE
(BY PERCENT OF EMPLOYEES)

Work Phases	1975 to 1980	1980 to 1985	1985 to 1990	1990 to 2000	2000 to 2010	2010 to 2020	2020 to 2030	2030 to 2040	2040 to 2050	2050 +
							Shallow Water Activity			
Exploratory Drilling	100	0[1]								
Development Drilling	33	100	90	0						
Production	5	33	100	85	65	30	20	0		
							Deepwater Activity			
Exploratory Drilling	100	0								
Development Well Drilling	5	33	100	50	33	0				
Production	5	10	33	55	100	90	65	30	20	0
							Average Activity			
Exploratory Drilling	100	0								
Development Drilling	20	80	100	40	15	0				
Production	5	20	75	75	100	80	50	30	20	0

Case 10[2]
(1 million BPD)
(Total Employees)

								Average Activity		
Exploratory Drilling	1,480	1,480								
Development Drilling	8,945	1,789	7,156	8,945	3,578	1,342				
Production	8,010	400	1,602	6,008	6,008	8,010	6,408	4,005	2,403	1,602
Total	18,435	3,669	8,758	14953	9,586	9,352	6,408	4,005	2,403	1,602

[1] Additional exploration in proven tracts is considered development.

[2] The percentages of average activity by timeframe is directly applicable to cases 1-9 as well. This will give projected manpower needed for other volumes of production. Only "Average Activity" percents may be used against total, as total employees are split between two phases, Shallow and Deepwater Activity. As a result the percent of activity by phase may not appear to balance to Average Activity. Derived total employee count may be rounded to nearest hundred.

Table III-32
Summary of Employment and Dollars into the Economy 1/
(Dollars in 000)

	Case 1	Case 2	Case 3	Case 4	Case 5
Annually (5 years) Exploratory Drilling					
Total Employees	1480	1480	1480	1480	1480
Total Salaries	29,600	29,600	29,600	29,600	29,600
Equipment Rentals	80,000	80,000	80,000	80,000	80,000
Purchases and Services	30,000	30,000	30,000	30,000	30,000
Annually (six years per Field) Development Well Drilling					
Total Employees	1790	2586	3382	4178	4974
Total Salaries	28,640	41,376	54,112	66,848	79,584
Equipment Rentals	26,800	38,726	50,652	62,578	74,504
Purchases and Services	9,600	13,872	18,144	22,416	26,688
Annually (40 years per Field) Production Operations					
Total Employees	1605	2318	3031	3744	4457
Total Salaries	22,470	32,452	42,434	52,416	62,398
Equipment Rentals	10,800	15,606	20,412	25,218	30,024
Purchases and Services	11,954	17,289	22,608	27,927	33,246
Capital Investments		(Millions)			
Total	2,465	4,128	5,791	7,455	9,120

1/ Case 1 indicates a mean production of 100,000 B.P.D. Each following case will be an additional like sum until case 10 is reached. Case 10 indicates a mean production of 1 million B.P.D. (40 year life).

Table III-32 (Cont'd.)
Summary of Employment and Dollars into the Economy
(Dollars in 000)

Annually (5 years) Exploratory Drilling	Case 6	Case 7	Case 8	Case 9	Case 10
Total Employees	1480	1480	1480	1480	1480
Total Salaries	29,600	29,600	29,600	29,600	29,600
Equipment Rentals	80,000	80,000	80,000	80,000	80,000
Purchases and Services	30,000	30,000	30,000	30,000	30,000
Annually (six years per Field) Development Well Drilling					
Total Employees	5770	6566	7362	8158	8945
Total Salaries	92,320	105,056	117,792	130,528	143,120
Equipment Rentals	86,430	98,356	110,282	122,208	134,150
Purchases and Services	30,960	35,232	39,504	43,776	48,048
Annually (40 years per Field) Production Operations					
Total Employees	5170	5883	6596	7309	8015
Total Salaries	72,380	82,362	92,344	102,326	111,650
Equipment Rentals	34,830	39,636	44,442	49,248	54,000
Purchases and Services	38,565	43,884	49,203	54,502	59,770
Capital Investments		(Millions)			
Total	10,785	12,450	14,110	15,780	17,351

Breakdown by types of employees and estimated wages can be found in Table III-23.

Table III-33

CAPITAL INVESTMENT[1]

(Case 10, 1 million BPD)

		Total (millions)
PLATFORMS	60 @ 15,000,000	$ 900
FLOATING PROCESSORS (For subsea production systems)	7 @ 17,000,000	119
EXPLORATORY WELLS	480 @ 3,100,000	1,488
SURVEY CHARGES	600,000,000	600
DEVELOPMENT WELLS Includes dry well costs and seabottom equipment (Christmas trees and gathering nets for subsea completions).	1980 @ 1,500,000 1980 @ 2,800,000 975 @ 5,000,000	13,389
PRODUCTION EQUIPMENT (Includes pumps and separators)	Oil - $400,000,000	496
LNG: Includes cost of 6 liquification modules and attendant equipment	LNG - 96,000,000	
PIPELINES	900 miles @ 200,000[2]	180
PIPELINE TERMINALS	2 @ 1,500,000	4
HARBOR TERMINAL (Improvements)	1 @ 1,000,000	28
FLEET		
LNG Carriers	5 @ 13,000,000	137
Personnel Carriers	15 @ 1,800,000	
Oil Tankers	15 @ 3,000,000	
SUPPORT & SAFETY BASES		10
		$17, 351

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[1] Estimated capital investment required for other base cases can be found in Table III- 32.

[2] This unit figure could be considerably higher depending on the number of pipelines laid in the pipeline corridor.

Table III-34

PRODUCTION
OPERATION COSTS
PRICE BASE 1972-73

(Case 10, 1 million BPD)

	Annual Cost $ Million
Manpower	
Field: 6615 persons $11,000 + 32% fringe	96.05
Support & Transportation, 800 $9,000 + 30%	9.36
Support, Tech & Clerical, 400 $11,000 + 30%	5.72
Terminal, 100 $10,000 + 30%	1.30
Contract, 50,000 Hrs, approx 100 $5-12/hr.	.39
	$111.65
Supplies	
Personnel	17.56
Industrial	33.54
Services	
Communications & Utilities	2.16
Repair & Well Workover	6.52
	59.77
TOTAL	$171.42

3. Oil and Gas Supply and Demand

The currently existing national energy problem in simplest terms is created by too little production in relationship to demand. In California, the problem is very similar and is basically an extension or part of the national picture. Since the development of any localized supply of energy is actually more of national issue than a local one, the impacts from increased oil and gas production will be addressed not only as they effect state or regional (PAD V) requirements, but national requirements as well. The following discussion will outline not only the projected outlook, but the historic as well. The reason being that a discussion of 100,000 barrels per day (BPD) or even 1 million BPD (production or consumption) is not significant unless it can be related to a present set of circumstances. To do this, excerpts from three different energy studies will be analyzed. These are:

1) Energy in California, January 1973, Oil and Gas Division, The Resources Agency, State of California.
2) The Market for and Supply of Oil and Other Forms of Energy, Final draft, August 1974, Sherman H. Clark Associates.
3) Preliminary Coastal Plan, California Coastal Zone Conservation Commissions, 1975.

Selected excerpts, as well as tables, from the study completed by the State of California, will be shown along with a table from the private study prepared for Western Oil and Gas Association. Both studies are very similar in their future demand projections. This will be followed by a summary utilizing a combination of data from the three sources.

Resources Agency, State of California

The demand for energy is governed by one factor - PEOPLE. Satiating the needs and desires of our population is the basic force motivating our economy. Since modern time there has been an uninterrupted growth of population, not only in the nation, but particularly in California. California's growth has been dramatic, and consequently our growth in energy demands has also been dramatic.

During the forecast period 1970-1985, it is estimated that the State's population will increase 30 percent, from 19.7 million to 25.6 million (California Department of Finance population projections). However, at current rate of growth, our energy demand will increase 100 percent, from 2.6 million equivalent barrels of oil per day to 5.2 million barrels.

A principal reason for the energy demand increase, which is more than three times the growth rate of the population, is the growth of the 20-34-age bracket. This age group is the largest consumer of goods and services, and commensurately, energy. Whereas this group now comprises 27 percent of the population, in 1985 they will comprise 34 percent. Over the next 10 years this group will increase at twice the rate of the population as a whole.

Another reason for the growth of California's energy demand is the continual increase in energy use per capita. Our ever-increasing standard of living goes hand in hand with energy consumption. In 1970, we used 48 equivalent barrels of oil per year per person; in 1985, we will use 74 equivalent barrels per year.

In all demand predictions there are varying degrees of uncertainty for the component segments, but there is a fairly good overall agreement on aggregate demand. A study which compared demand forecasts (Battelle Memorial Institute, 1969) showed a general agreement of forecasts of total demand through 1980.

Most energy economists concur that predictions beyond 15 years are tenuous at best as changing technology becomes too large an unknown factor. In the long term, such other factors as production of synthetic oil and gas, and changes in cost relationships and lifestyles may also appreciably affect energy requirements.

Traditionally estimates of future demand have been on the low side. A study published in 1963 predicted U.S. oil yearly consumption at 5.34 billion barrels by 1980; this rate was reached in 1970. (Oil and Gas Journal, 1963). Component estimates are even more hazardous and subject to technological influence. Estimates of aviation gas consumption made during the late forties and fifties proved to be off by several orders of magnitude as the rapid increase in jet aircraft was not anticipated.

As shown on Figure III-8, by 1985 California's total oil production will be about 500 thousand barrels per day, far short of our demand of 2.97 million barrels. Under optimum conditions and with full development of our offshore and onshore resources, including Federal Outer Continental Shelf, by 1985 our production could be more than 2.0 million barrels per day. Additionally, if the Elk Hills Naval Petroleum Reserve, with an initial capacity of 160 thousand barrels per day were produced, by 1985, 55 thousand barrels per day would still be available.

By 1985 then, California's production from all sources could be as much as 2.6 million barrels per day. This would make our daily oil deficit only 370 thousand barrels as opposed to 2.47 million barrels if we follow our present course.

This, coupled with California's share of the 2.0 million barrels per day expected from the Alaska North Slope, could make California essentially independent from unstable foreign supplies through 1985.

It is possible that alternate sources of oil from coal or oil shale could provide some oil to California, but it will be 15 years before we have the capability to produce significant amounts of oil from these resources, and California has no oil shale or significant deposits of coal. Therefore, any products from these sources would have to be imported and with the current requirements of the other states involved, there is no assurance that California would receive any of these products.

Regardless of where we obtain our oil, it still has to be refined to be of use. To process our 1985 demand, California's refining capacity of about 1.7 million barrels per day will have to be increased by about 70 percent. This means that seven new refineries the size of the giant Richmond facility would have to be constructed. This number will be even larger if California continues to refine products for use in other western states.

Gas

Natural gas provides 40 percent of California's total energy requirements. It supplies approximately 94 percent of the residential and commercial energy needs, 50 percent of the requirement of steam electric plants, and 56 percent of the industrial demand.

The emphasis being placed on improving our air quality, particularly in the Los Angeles region, will further accentuate demand for natural gas because of its clean-burning qualities. During the last few years, demand for natural gas has exceeded the growth rate demand for total energy. However, an acute shortage already exists which will preclude further growth. The supply will remain nearly static through 1985 with oil making up the difference between supply and demand.

Although California imports three-fourths of its natural gas needs, a strong indigenous base is still important. California's total domestic proved reserves of natural gas now available to our markets has been declining since 1963. As of December 31, 1971, the total proved reserve of natural gas in California was approximately 7.5 billion Mcf. Our present rate of consumption is 5.7 million Mcf. per day or 1.1 million equivalent barrels of oil. California production is steadily declining and by 1985 will be about 1.0 million Mcf. per day (Figure III-9), or only 17 percent of our demand compared to 28 percent in 1970. If new discoveries of natural gas are not found to augment our reserves, greater shortages will surely prevail.

California's gas production comes from two sources, that which is produced from gas fields (dry gas) and that which is produced in association with oil (wet gas). There is a large potential reserve of both wet and dry gas that lies undiscovered in California's major hydrocarbon-producing basins. Generally, the discovery of a large oil reserve means the discovery of a large gas reserve, so if oil drilling is resumed in offshore areas, substantial reserves of gas will be found.

Summary

The State of California report was prepared in January 1973 prior to the energy crunch. This report as noted, basically agrees with the report completed in the private sector after the energy shortage. Since publication of the draft environmental impact statement

(Sale #35), we have been advised by the Resources Agency that their report can no longer be considered valid. Attempts to get the Resources Agency to update their report "Energy in California" has met with negative results. Energy forecasting passed from the Division of Oil and Gas, to the Energy Planning Council in late 1973 until the end of 1974. This body is now defunct and forecasting responsibilities are now under the Energy Resources Conservation and Development Commission.

In the past two and a half years since the publication of "Energy in California", the state has not published any forecasts past 1975 to our knowledge. We have been informed that a report of this nature has been contracted for but is not presently available.. In lieu of an official state position on this matter, we will present data from the last publication available. It should be pointed out that our forecast (which follows) of consumption levels to 1985 is sharply below the level projected by the State of California in their 1973 report.

In 1973 total energy consumption in the United States rose 4.8 percent to a new high, even though total population increased less than 1 percent. Percentage-wise energy consumption in 1973 rose six times faster than the population increase (4.8% vs. 0.8%). United States energy consumption data for 1974 indicated a 2.2 percent decline as compared to a year earlier. This is the first drop in total energy use in over 20 years in the United States. The Arab oil embargo combined with a mild winter and poor economic outlook were influencing factors.

At the end of January 1975 the picture was shifting again as petroleum demand was up 4.1 percent from the same month a year earlier. Petroleum consumption for February, March and April 1975 reflected increases between 1.5 to 2.9 percent. These indications point to an increase in consumption of petroleum products but at a rate below growth levels of the past decade.

The basics that an analysis of these three reports indicates is that oil and gas production in California is decreasing while consumption or demand is increasing. The increase in oil consumption is going up sharply (Figure III-20) while gas consumption is reflecting a shallow rise (Figure III-21). Natural gas provides an estimated 40 percent of the total energy requirement in California but approximately 3/4 of this is imported from southwestern states and Canada. (Table III-35). Oil consumption in California provides approximately 1/2 of the state's total energy requirement which includes 100% of its transportation fuel and 41% of the industrial energy requirement. Consumption of oil in 1973 was approximately 1,715 thousand barrels per day of which 933 thousand (since revised downwards to 921) barrels per day was produced within the state (including the Federal O.C.S.). In 1973, total O.C.S. (State and Federal waters) petroleum in California accounted for more than 1 out of 4 barrels. Total production in 1973 was equal to 54 percent of consumption in the state. This percnetage would be even lower if it considered the oil sent to Nevada and Arizona.

California's oil production and consumption were equally balanced at approximately 850,000 barrels per day in the late 1950's. Since then, consumption has steadily increased while production hit a peak of 1,022,000 barrels per day in 1968 and has steadily declined since that point. The current spread between production and consumption in the state is approximately 800,000 barrels per day. This shortfall is estimated to reach 2,327,000 (Sherman Clark Associates) to 2,500,000 (State Resources Agency) barrels per day by 1985 assuming no further development (Figure III-20,Table III-35). If California were to receive not only a share of the estimated Alaskan production, but did in fact, receive the total estimated output of 2.0 million barrels per day by 1985, there would still be a shortage of between 300,000 and 500,000 B.P.D. (based on these two projections).1/ The Bureau of Land Management forecast differs from these two reports in that there would be an anticipated surplus of crude petroleum by 1985 of 240,000 BPD, assuming no further development in California, and further assuming we receive 2 million BPD from Alaska.

It should be pointed out that it is highly unlikely that California would receive more than 1.6 million BPD from Alaska (by 1985) unless other major developments are undertaken in this northernmost state. If we assume (1.6 million BPD) Alaskan imports at this level for California consumption, and further assume no further petroleum development 160,000 BPD would be created. This forecast is based on a 3.0 percent per annum demand increase and excludes other imports.

A demand growth rate of approximately 4.7 to 5.0 percent was used to project demand until 1985 in the Sherman Clark Associates

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1/ Since we are assuming no further development in the OCS, the Federal OCS projection of 600,000 BPD in the S. Clark report for 1985 has been reduced to 50,000 BPD (current production).

and State Resources Agency two reports. The Preliminary Coastal Plan, in contrast, states (pp. 165) that with vigorous conservation efforts and increased development of California's potential recoverable onshore and offshore oil resources, a huge in-State deficit is by no means inevitable.

Federal Energy Administration (FEA) forecast of energy demand as reported in "Project Independence report, November 1974", vary from a low of 2.7 to a high of 3.2 percent annual growth rate to 1985. The growth rate in their report is tied directly to the price of imported oil. The low case (2.7 percent) is projected with $11.00 per barrel imported oil and the high case (3.2 percent) with $7.00 a barrel imported oil. A demand forecast based on crude oil only, was not provided in this report. It was pointed out that FEA's forecast of energy consumption thru 1985 is very optimistic and substantially lower than most published forecasts. The following table from the FEA Report compares their forecasts with other energy demand forecasts.

Comparison of Forecasts of Energy Demand
(In Quadrillion Btu's)

	1972	1985	% Change 1972-1985	Compound Annual Rate of Growth 1972-1985
FEA ($11/BBL Import Price)	72.1	102.9	43	2.7%
FEA ($7/BBL Import Price)	72.1	109.1	51	3.2%
Dupree-West (D-W)	72.1	116.6	62	3.8%
Ford Foundation (EPP)				
High Case	72.1	115.0	60	3.7%
Low Case	72.1	93.0	29	2.0%
Nat'l. Petroleum Council (NPC)				
High Case	72.1	114.9	101	5.5%
Low Case	72.1	124.9	73	4.3%

If growth in consumer demand in California was in fact reduced to 3.0 percent, the savings in total consumption would be approximately 500,000 BPD by 1985. Total daily consumption would be depressed from 2.95 million BPD to 2.45 million BPD. If daily production by 1985 was estimated at 700,000 BPD, the shortfall between production and consumption would be approximately 1,750,000 BPD. This estimated shortfall is slightly more than the total oil consumed daily in California at the present time.

In order to determine what effects resulting oil and gas would have on supply and demand by 1985, if the sale takes place, certain assumptions must be made on which to base the projection.

These are:

Oil

1. A decrease in annual consumer growth demand in California from over 7 percent to 3 percent (approximate midrange FEA forecast).1/
2. A decrease in current state production including federal and state OCS operations at an average of 2.5 percent per year.2/
3. Estimated daily Federal OCS production as a result of this one sale at a maximum of 650,000 BPD by 1985 (high case).
4. No other new major oil and gas development projects undertaken in California.

Assuming these premises are valid, their application would have the following effect thru 1985.

California Oil, Supply and Demand
1973 - 85
(Thousands of Barrels per Day)

	1973	1978	1982	1985
Consumption	1715	1988	2238	2445
Production				
State & OCS	921	814	737	685
New OCS	0	45	400	650
Total	921	859	1137	1335
Shortfall	-794	-1129	-1101	-1110

1/ Two other cases showing the effect of the FEA low and high case energy demand forecasts as applied to petroleum consumption in California can be found in Appendix 24, Volume 3 (2.7 and 3.2 percents).

2/ State production declined 24 percent in the most recent 5 year period (1969 - 74)
California OCS production has declined approximately 46 percent between 1971 - 74.

Gas

Daily production would be estimated to increase from 1,407,000 MCF to 2,100,000 MCF (assuming approximately 1,500 cubic feet of gas per barrel of oil or approximately current production rate from all sources).

As a result of this sale, the reduced shortfall between petroleum supplied by California production and demand in California is anticipated at 1,100,000 BPD between 1978 and 1985 as compared to as high as 1,750,000 BPD if it does not take place. This of course, is an optimistic estimate assuming a high case development (case 10) and further assuming a decrease in annual consumer growth demand to 40 percent of the 1973 level. The current shortfall of 800,000 BPD would be increased approximately 38 percent and would be further strained by increased demands from other states within the PAD V service district (Arizona and Nevada). This is not to say that the situation will become more critical if the sale takes place, but that the widening spread between supply and demand, which is anticipated to become more critical, will do so at a reduced pace. As can be seen, federal offshore production would only help to meet local requirements and there would be no excess in local production to help alleviate the national problem. This would be true even if demand remained static. Thus, for both Southern California and the state, substantial imports of Alaskan or foreign crude oil into the state will still be required by 1985.

The natural gas situation is very similar to the oil picture. Increased consumption in 1973, while production was off over 7 percent (in California). If dry gas zones are not developed, the estimated production increase could disappear. Out of state's supplies will continue to be needed even in the event of the sale taking place.

One major petroleum company has stated that imports of low sulphur Indonesian crude will probably continue to be imported to the west coast in order to balance product quality and mix requirements. Assuming imports of 300,000 BPD to California by 1985 would create a crude surplus of between 150,000 to 800,000 bbl's per day if consumer demand growth increased at a 3 to 5% annual level to that period. This surplus could be further swelled by anticipated Santa Ynez production.

The Preliminary Coastal Plan's energy section is in general agreement with the above analysis. In the plan's petroleum supply and demand section, pages 163-167 it states, "California petroleum demand at present outstrips in-State production, and the deficit is likely to increase. (E-f5)" It continues to say that new sources of supply will be needed to meet even a reduced demand. These new sources could be: increased development of in-State onshore resources, development of the State and Federal OCS or foreign and Alaskan imports.

The Plan projects a lowering of demand growth due to conservation efforts, higher oil prices, and the development of alternative energy resources. The shortfall of in-State production and in-State consumption will be compensated for with the advent of Alaskan crude in 1978.

Summary

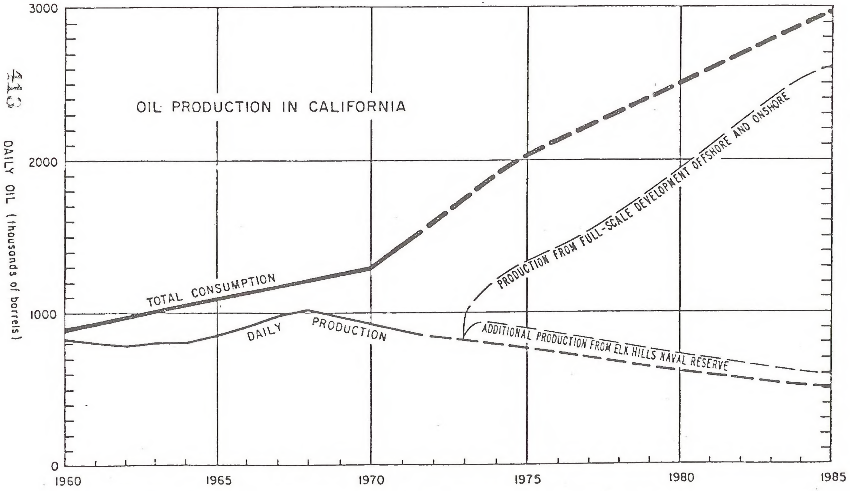
Consumption of petroleum products in California outstrips production at the present time and the gap will widen in the future unless State production can be increased. OCS production can reduce the gap and thereby reduce foreign imports and reliance on Alaskan production. More Alaskan crude would then be available to alleviate the national energy crisis.

Effects of Alaskan Crude

As can be seen in the preceeding table, the shortfall between 1978 and 1985 would be virtually unchanged at approximately 1,100,000 BPD. Increased new OCS production would be expected to offset the increase in consumer demand (@ 3 percent per annum) as well as make up for the anticipated production decrease in current operations. This shortfall in California production could be satisfied in 1978 by 1.2 million barrels of Alaskan crude from both the Cook Inlet, and the North slope by way of the Trans-Alaska Pipeline (TAPS). If the quantity of Alaskan crude to California was increased as expected to 1.4 million bbl's in 1982 and 1.6 million 1/ bbl's by 1985, it could result in an oil surplus of between 300,000 to 500,000 barrels per day during this period, excluding imports from foreign sources. Again, this is assuming a 3 percent growth rate in consumer demand. If current efforts to reduce consumption are not successful and consumer demand increases at an average level of 5 percent per year, the surplus would be absorbed and a deficit created in its place. Consumption by 1985 would reach 3,080,000 bbl's per day, and even with 1.6 million bbl's of Alaskan crude, a deficit of 145,000 bbl's per day would be created. Anticipated peak production of 75,000 bbl's per day from the Santa Ynez unit which is five miles off the California coast between Point Conception and Santa Barbara, could make up half of this deficit. The balance would have to be made up by other sources.

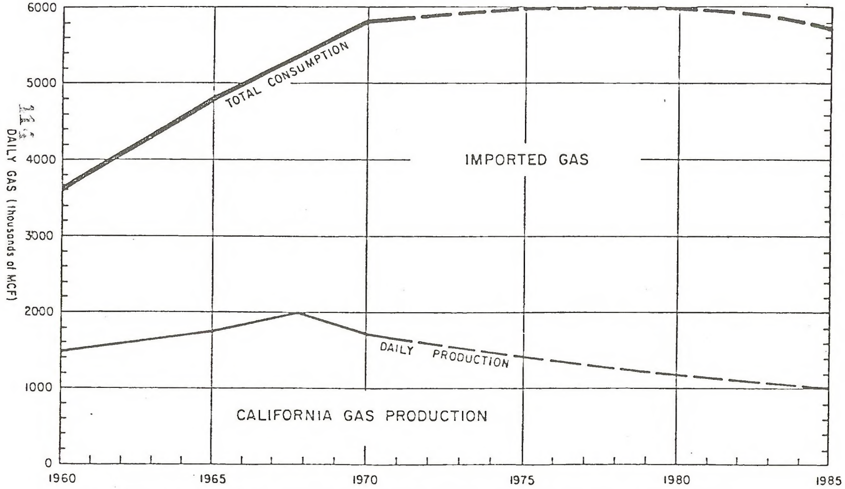
1/ Total estimated available oil from TAPS is 2 million bbl's per day by 1982, but other States' demands must also be satisfied.

Figure III-20



Source: *Energy in California*, January 1973, The Resources Agency, State of California

Figure III-21



Source: *Energy in California*, January 1973, The Resources Energy Agency, State of California

Table III-35

ALTERNATIVE I* OIL SUPPLY AND CONSUMPTION IN REGIONS OF DISTRICT V
(Thousands of Barrels per Day)
1972-1990

	District V 1					Total California+					Southern California					Rest of District V‡				
	1972	1973	1980	1985	1990	1972	1973	1980	1985	1990	1972	1973	1980	1985	1990	1972	1973	1980	1985	1990
Refinery input																				
Crude oil																				
Domestic																				
Alaska	191	201	1,600	2,211	2,858	132	127	1,121	1,556	2,062	87	83	740	854	1,215	59	74	479	655	796
California	968	933	800	650	550	968	933	800	650	550	639	616	528	429	363	0	0	0	0	0
California federal offshore§	0	0	67	600	600	0	0	67	600	600	0	0	67	600	600	0	0	0	0	0
District IV	31	28	25	25	25	31	28	25	25	25	31	28	25	25	25	0	0	0	0	0
District III	2	5	0	0	0	2	5	0	0	0	2	5	0	0	0	0	0	0	0	0
Subtotal	1,192	1,167	2,492	3,486	4,033	1,133	1,093	2,013	2,831	3,237	759	732	1,360	1,908	2,203	59	74	479	655	796
Foreign																				
Canada	258	242	50	0	0	0	0	0	0	0	0	0	0	0	0	258	242	50	0	0
Other	403	566	637	170	206	284	420	499	0	0	165	257	322	0	0	119	146	138	170	206
Subtotal	661	808	687	170	206	284	420	499	0	0	165	257	322	0	0	377	388	188	170	206
Total crude	1,853	1,975	3,179	3,656	4,239	1,417	1,513	2,512	2,831	3,237	924	989	1,682	1,908	2,203	436	462	667	825	1,002
Stock change	+4	-1	0	0	0	+4	-1	0	0	0	+2	-1	0	0	0	0	0	0	0	0
Total crude runs	1,849	1,976	3,179	3,656	4,239	1,413	1,514	2,512	2,831	3,237	922	990	1,682	1,908	2,203	436	462	667	825	1,002
Unfinished oils	38	37	35	35	35	38	37	35	35	35	25	24	23	23	23	0	0	0	0	0
Other hydrocarbons	74	66	70	70	70	64	56	60	60	60	42	37	39	39	39	10	10	10	10	10
Total input	1,961	2,079	3,284	3,761	4,344	1,515	1,607	2,607	2,926	3,332	989	1,051	1,744	1,970	2,265	446	472	677	835	1,012
Processing gain	61	81	102	116	134	17	50	81	91	103	31	32	54	61	70	14	31	21	25	31
Total refinery supply	2,022	2,160	3,386	3,877	4,478	1,562	1,657	2,688	3,017	3,435	1,020	1,083	1,798	2,031	2,335	460	503	698	860	1,043
Other receipts																				
Net product receipts from Districts I-IV	115	99	100	100	100	0	0	0	0	0	0	0	0	0	0	115	99	100	100	100
Net product imports	26	41	0	0	0	26	41	0	0	0	40	57	0	0	0	0	0	0	0	0
Transfers from crude oil	3	10	10	10	10	3	10	10	10	10	2	7	7	7	7	0	0	0	0	0
Stock changes	+7	-11	0	0	0	+6	-7	0	0	0	+4	-5	0	0	0	+1	-7	0	0	0
Total oil supply	2,159	2,324	3,496	3,987	4,588	1,585	1,715	2,698	3,027	3,445	1,058	1,152	1,805	2,038	2,342	574	609	798	960	1,143
Consumption, of which:																				
Gasoline■	966	1,066	1,380	1,658	1,966	724	751	1,055	1,261	1,489	466	484	692	827	990	242	255	325	397	477
Jet fuel	319	304	394	469	554	230	220	285	343	408	144	137	171	203	242	89	84	109	126	146
Distillate	277	314	534	621	733	160	182	354	401	468	104	120	275	307	348	117	132	180	220	265
Residual	321	421	732	755	824	242	331	603	598	633	180	246	368	389	437	79	90	129	157	191
All other	276	279	356	384	411	229	231	301	324	347	164	165	219	232	245	47	48	55	60	64
Total domestic consumption	2,159	2,324	3,396	3,887	4,188	1,585	1,715	2,598	2,927	3,345	1,058	1,152	1,725	1,958	2,262	574	609	798	960	1,143
Net product exports•	0	0	100	100	100	0	0	100	100	100	0	0	80	80	80	0	0	0	0	0
Total consumption	2,159	2,324	3,496	3,987	4,588	1,585	1,715	2,698	3,027	3,445	1,058	1,152	1,805	2,038	2,342	574	609	798	960	1,143

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* Alternative I oil supply assumes a high level of oil availability from Alaska and from California federal offshore.
+ Includes markets served in Nevada and in Arizona.
‡ Alaska, Hawaii, Pacific Northwest and a portion of Arizona.
§ Assumed to all go to Southern California refineries; some may in fact also go to Northern California refineries.
■ Includes ethane and special naphthas.
• Consists of high sulfur coke and fuel oil and various specialty products.

Source: Developed by S. H. Clark Associates.

[1] District V includes the states of California, Arizona, Nevada, Oregon, Washington, Alaska and Hawaii.
Editors Note - 1972-73 California Federal offshore production has been included in California production for both California and Southern California.

Source: The Market For and Supply of Oil and Other Forms of Energy, Final Draft, Aug. 1974, Sherman H. Clark Assoc.

4. Offshore Minerals

At the present, offshore mining technology for the retrieval of authigenic and terrigenous mineral resources is in its infancy. Minor amounts of work are going into the development of mining hardware and retrieval systems, since the economical value of minerals (as discussed in Section II.A) in the Borderland do not warrant retrieval in the forseeable future. With a change in the mineral economic condition, mineral retrieval may be justified. Although little interest has been expressed to date in the minerals within the Borderland, it can be anticipated that in the future the offshore minerals may become a major source for such resources as phosphorite, manganese, iron and sand and gravel. Immediate retrieval of these and other minerals may not be possible in areas that are leased for oil operations.

The mineral retrieval systems will vary with the type of mineral resource to be recovered and the depth at which the deposit is located. The various types of mechanical systems which could be used are: airlift hydraulic dredge, bucket dredge and wire line dredge.

From this range of mechanical systems it is obvious that the bottom disturbance will vary with the specific type of equipment used to extract the mineral. The disturbance that would occur with an airlift type dredge will be minimal, whereas a bucket dredge may alter the topography significantly. Therefore, nonretrieval of minerals within or around the proposed lease areas could be a consequence of oil operations, since the mineral and extraction equipment could disturb or severely damage the hardware of the oil operations on the ocean floor in the water column.

More than one mineral lease may be issued for the same area for the retrieval of other types of minerals but CFR 43, Part 3307.4-5 provides that other leases may not unreasonably interfere with or endanger operations of any existing lease. Therefore, once any oil production areas have been leased, any type of operation that could be potentially hazardous to oil operations would be restricted from functioning within and around the lease area. The safety zone between oil production operations and those operations for offshore minerals will have to be determined on a site or area basis, i.e. the safety zone will depend on examination of such parameters as slope stability, sediment type, topography and type of mineral retrieval system to be used.

Offshore hardware that would have the highest probability for possible damage by mineral extraction equipment are main pipelines, gathering pipelines from subsea completions and subsea completions clusters. Gathering pipelines from the subsea completions to the subsea clusters will create the greatest obstruction for the offshore mining operation. The main transfer pipeline which would connect different lease areas and possibly these areas to onshore facilities would create a hazardous corridor area from which ocean mining equipment will also be restricted. The width of the corridor may be as narrow as 400 feet on either side of the pipeline or as wide as 4,000 feet in areas where submarine slides, creep, unconsolidated material, or slumping may be a hazard.

From the 2400 sq. mile proposed lease sale area, we can anticipate that offshore mining will be restricted from operation for an area of 28% to 48% (maximum case development as discussed in economical impact) of the proposed lease area. This area of restriction was derived from the following table, showing the maximum case development, from which 38% of the proposed lease area will be off limits for mining. It is felt that a 10% deviation could be considered, thus giving the conclusive range of area (28% to 48%)that could be restricted from offshore mining.

Restricted Mineral Development Area

Hardware	Area of Use (sq. Mile)	Remarks
60 Platforms	125	Assume 66 wells per Platform
7 Subsea Clusters	35	Assume 135 Subsea Completions per Subsea Cluster
500 miles of Transfer Pipeline	68 - 680	Assume 400-4000 ft. on each side of the Pipeline Corridor will be within area
Total Area	228 - 840	

Total unusable area for offshore mining due to oil operation, will be 38% ± 10% of the proposed 2400 sq. mile oil lease area.

Minerals that are not retrievable due to oil operations can be recovered once oil productions have ceased (20 to 40 years). This will make some offshore minerals within the Borderland temporarily unobtainable.

Portions of oil spills or seeps occurring as a result of the proposed offshore oil operations could have an irreversible impact or could greatly interfere with any future mineral extraction operations. Seeps usually occur as a result of natural condition whereby oil will find its way to ocean floor surface through porous material or path of least resistance. Seeps are also man induced, as seen in the case of Santa Barbara, 1969. Since 1969, oil in the Santa Barbara Channel has continued to seep from the ocean floor at a rate of about five barrels per day through the fractured caprock. A negative pressure differential must be maintained between the ocean floor and the upper oil reservoirs to prevent further seepage.

Liquid hydrocarbon material that would escape to the marine aquatic environment, which may have a density greater than that of ocean waters, will sink and could cover the local ocean floor with an oil or tar covering. This covering may restrict or interfere with minerals retrieval due to thick oil and/or tar covering or bonding of the minerals.

The fate of oil spills and seeps is dependent on numerous dispersive forces i.e.,evaporation of volatile components, dissolution of soluble components, surface spreading, differential transport by currents, emulsification and sinking, and deposition upon the shoreline. Rates at which these processes proceed is dependent on such factors as sunlight intensity, wind speed, turbulence, temperature, salinity, bacterial content of the medium, and nature and quantity of the oil. With this matrix of forces and affecting factors, it is only possible to discuss qualitatively the impact of offshore mineral resources due to oil spills and seeps (Allan Hancock Foundation is currently engaged in the development of a model for the fate of oil in the ocean).

In the nearshore marine environment as much as 30% of an initial spill could reach the ocean floor. A spill the size of the 1969 Santa Barbara blowout (100,000 barrels) could have as much as 4770 cubic meters of oil reaching the ocean floor. This volume would cover an area of 4.77 million sq. meters (1.84 sq. miles) at a thickness of 1 mm.

Due to the lower content of particular matter and suspended sediment content in the water column of the deep offshore areas, less oil will settle to the ocean floor in deep marine areas.

Oil that sinks to the ocean floor can be degraded in aerobic areas. If oil accumulations move into deep basins, where anoxic conditions are present, further deterioration of the oil will be greatly decreased or stopped.

Oil that settles in nearshore areas or basins could form an oil coating on the ocean floor. These coatings could incorporate particulate matter, sediment and small diameter minerals. This coating which could prevent mineral retrieval is felt to have an insignificant effect on offshore mining.

5. The International Environment

Any negative impact resulting from the proposed action on the international environment will be limited to the Pacific Coast of Baja California, Mexico. The negative impact will be limited to the drifting of oil resulting from offshore spills which is not contained in any cleanup operations. Because of the distances (100 + miles) of the lease acres under consideration from the coast of Mexico, it is anticipated that the oil will have lost the lighter, more toxic fractions through volatization. As a result, if a spill does reach Mexico, depending on size, location, and weather conditions, the heavier fractions of the oil may survive the transit and be a possible cause of any negative impact.

Since the major portion of the shoreline of Baja California is pristine in nature, the oil resulting from a spill could cause noticeable damage. The most critical areas of impact will probably be the bays, marshes, and estuaries. Since these areas serve as the incubating sites for much of the marine life, damage to the young species would result from suffocation or from toxic effects. Since very little investigation has been done and documented on the extent of the biota in these areas, it is not possible to ascertain the extent of damage which might result from the introduction of surface crude oil. The damage, however, could be substantial. See Section III.D.2. concerning the papers by North and the Tampico spill.

Besides the marine life in the bays, marshes, and estuaries, the intertidal communities can be affected in ways similar to those already reported for the California coast. Any reduction of life will last for about one year, or until the next seasonal mating and reproduction activities have occurred. Biological recovery (the time required for the decimated population to reach reproductive age and reproduce) will take several years longer.

There are several endangered species (listed by the U.S. Fish and Wildlife Services) located in the area of the coast of Mexico. The list includes the following:

Leatherback Turtle
California Brown Pelican
Southern Bald Eagle
American Peregrine Falcon
Light-footed Clapper Rail
Yuma Clapper Rail
California Least Tern
Blue Whale
Gray Whale
Finback Whale
Humpback Whale
Right Whale
Sei Whale
Sperm whale

In addition, the following are listed by the State of California as rare species:

Guadalupe Fur Seal
California Black Rail

See Section III.I.6. of this statement for a discussion of possible impacts from oil spills on threatened species.

A certain amount of air pollution over the onshore areas may also result from an oil spill. Since the lighter ends of the crude volitalizes, the air pollution characteristics are expected to be similar to those discussed elsewhere. The major difference between an oil spill on offshore Mexico from that of offshore California is that most of the volatile parts probably will have evaporated during the transit period. The churning of the ocean and the sea breezes will have caused most of the evaporation to have occurred before the spill reaches Mexican waters, thus resulting in a minor or no impact onshore.

A spill that reaches shore could have a disruptive effect on recreation on the shore and near shore. Sportsfishing activities could be disrupted and boats become soiled from the floating crude. The impact will probably be more disruptive in nature and is not considered to be substantial.

Some beaches and other water-land areas could become covered and soiled by the oil. Since most of the shoreline is undeveloped, most of the disruption will be in the vicinity of the urban and resort areas. As a result, fishing, swimming, diving, and sunbathing activities may be inconvenienced during a clean up period. A negative esthetic impact will also occur during that period.

Since the major fishing activities occur further south, little negative impact from an oil spill will be felt by the fishing industry in comparison with that felt off the California coast.

An impact resulting from the proposed program would result if the oil companies decided to construct onshore facilities in Mexico. Since strict environmental regulations do not exist in Baja California, the decision to place refineries and other related facilities onshore may become economically attractive. It is not known if any investigation along these lines have taken place, but the possibility does exist.

If onshore facilities were placed in Mexico, the economic situation of the particular area or areas could be enhanced. Employment would result, new taxes would be generated, certain spinoff economies would be created, and new dollars would enter the local economy.

Any onshore development would result in a long term land use change similar to those discussed earlier. Certain open areas would be developed, and the impetus for further urban development would be present. In addition, some agricultural acreages could be removed from production in order to accommodate the more intensified industrial uses.

K. Proximity Evaluation

1. Purpose

This section is a presentation of the proximity of tracts (and impact producing factors which may result from their development) to natural and cultural resources and multiple use activities. The purpose is to portray and evaluate this proximity as a first step in presenting the decision-maker and reviewer with a tract-by-tract environmental analysis. Following this proximity evaluation and recapitulation is a summary risk analysis which takes into account both information derived from this evaluation and other factors in determining the relative environmental risks posed by each tract. The proximity evaluation is a generalization, its accuracy and usefullness varies with the resource. More detailed discussions of specific resources are covered under their appropriate impact section in this EIS.

In this section, each tract is included in a table(appendix 17) designed to describe its distance from shore (either island or mainland) and its distance from significant resource factors as outlined below. In addition, the proximity to these resource factors of oil spills, if one should occur from a tract, and of structures, should the tract be developed, is evaluated by means of a proximity scale. Each tract is assigned a proximity number for both oil spills and structures.

2. Significant Resource Factors

The tracts proposed for offering in this sale are evaluated with respect to their proximity to significant resource factors which include natural and cultural resources and multiple-use activities. These factors are listed below with explanations of how the measurements were made for each factor.

Natural and Cultural Resources

Refuges/Wildlife Management Areas: Measurements were taken from the center of each tract to the nearest shoreline of these refuges or management areas which were set up to protect intertidal and extremely nearshore communities. The only exception here was Farnsworth Bank, south of Santa Catalina Island for which measurements were made from the center of the tracts to the center of the bank.

Kelp Beds: Measurements were made from the center of each tract to the nearest kelp bed, most of which are shoreward of the 30 meter depth contour.

Bird Rookeries: Measurements were made from the center of each tract to the nearest point on shore, considering the broad extent of nesting and breeding grounds.

Seal Rookeries: Measurements were taken from the center of each tract to the shoreline of the nearest rookery area.

Rocky Shore-Intertidal Areas: Measurements were made from the center of each tract to the nearest shoreline of this type.

Sandy Beach-Intertidal Areas: Measurements were made from the center of each tract to the nearest shoreline of this type.

Aesthetics: Measurements were made from the center of each tract to the nearest shoreline except that of San Clemente Island. For the purpose of this evaluation "aesthetics" refers to the visibility of structures or oil spills impacting on the aesthetic quality of the view from shore, whether that shoreline be used for residential purposes or recreation.

Archeology: Measurements were made from the center of the tract to the 150 foot contour which approximates the seaward extent of the shoreline since man has inhabited the area. (There is evidence that the offshore islands as well as the mainland were prehistorically inhabited by man.)

Multiple-Use Activities

Shipping: Measurements were made from the center of the tract to the nearest commercial shipping fairway, designated submarine lane, or prohibited dumping area.

Outdoor Recreation: Measurements were made from the center of each tract to the nearest shoreline or other intensively used recreation areas such as boating, fishing or diving areas.

Commercial Fishing: Measurements were made from the center of each tract to the nearest 10 million pounds per year catch blocks as defined by the California Department of Fish and Game.

Sport Fishing: Measurements were made from the center of each tract to the nearest shoreline.

Military Use: Measurements were made from the center of each tract to the nearest missile test range or fleet maneuver area.

(See section II, Description of the Environment, for detailed descriptions of each of these resources, and activities, and section III for the detailed analyses of the various impacts they could sustain.)

3. Impact Producing Factors

This evaluation considers the proximity of the occurrence of oil spills and structures to significant resource and activities in the proposed sale area. "Oil Spills" in this context refers to a spill of 1000 barrels or more, and "structures" includes platforms, fixed structures, and artificial islands. Other impact producing factors such as debris, pipelines, and other transportation modes cannot be treated on a tract-by-tract basis, but they are considered in detail elsewhere in this statement.

4. Proximity Values

Each tract has been assigned proximity values for oil spills and structures based on its distance from significant resource factors.

a. Oil Spills

Observations for oil slicks indicate an average drift rate at approximately 3% of the surface wind speed in the direction of the wind. 1/ Therefore, this simple formulation will be applied to the extensive wind data available for offshore Southern California compiled

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1/ The 3% figure is an order of magnitude figure which, in our estimation is more representative of the open ocean than are some of the values reported in the literature pertaining to confined bays or semi-enclosed waters.

by the U.S. Naval Weather Service Command (1970), for monthly wind patterns based on records dating back to 1884, to determine the shoreward drift rate of an oil slick. 1/ This estimate in turn will serve as a basis for assigning proximity values to each tract in terms of its relation to shore or high value, vulnerable resources. It should be emphasized that the estimated direction and rate of oil slick movement is an approximation of the driving force exerted upon an oil slick by the wind. It does not consider slick geometries, natural dispersive forces, evaporation, absorption, dissolution or emulsification rates, and other forces that could cause cessation of the spreading movement of a slick.

Winds from the southeast, south, southwest, west, and northwest are likely to carry an oil spill (should one occur) toward some shoreline. The following table gives the percent frequency by month of these offshore winds in the area of concern (U.S. Naval Weather Service Command, 1970). (Table III-36)

From the table it is apparent that the prevailing winds are from the west and northwest. It is also apparent that onshore winds are predominant throughout the year but are most frequent in summer. Based on the monthly mean wind speeds of these onshore winds, should an oil spill occur, it could move toward shore at an estimated rate of 0.2-0.4 knots.

1/ A shoreward rate of drift is the single most important factor involved in estimating time and possible impact points of an oil spill on nearshore or onshore high value, vulnerable resources.

Table III-36

Percent Frequency of Onshore Winds

DIRECTION	JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
SE	5.6	3.9	5.1	3.6	2.6	4.3	2.1	2.4	2.3	3.6	4.3	5.5
S	6.3	4.6	6.0	7.4	5.5	7.1	5.2	5.8	3.7	4.9	5.7	5.5
SW	6.1	6.6	7.8	9.5	10.4	10.6	9.0	9.6	6.7	7.7	6.3	6.6
W	20.5	27.0	32.2	35.0	40.3	39.2	39.2	40.1	35.3	29.7	25.0	20.3
NW	28.7	32.2	31.5	31.8	31.3	29.3	34.0	31.4	38.7	34.8	32.2	29.1
TOTAL ONSHORE	67.2	74.3	82.6	87.3	90.1	90.5	89.5	89.3	86.8	80.7	73.5	67.0

For purposes of evaluation we have established a proximity scale which is based on the following assumptions:

a) An oil spill of 1000 bbl. or more has occurred.

b) The rate of shoreward drift of an oil spill in the study area during mean annual wind velocities is estimated at 0.2-0.4 knots. For purposes of this evaluation the 0.4 knot rate will be used.

c) The shoreward movement of an oil slick is most likely in the early summer, but no distinction concerning the season will be included in the proximity scale. All tracts are considered to be in areas that could produce a shoreward drift of an oil slick at any given time should a spill occur.

d) A 12-hour response time is necessary to implement contingency measures to stop or retard oil from reaching shore, or high value, vulnerable resource area.

Each tract has been assigned a value for oil spills from the following scale:

PROXIMITY SCALE (Oil Spills)

1.0 - Tract is within 6.0 statute miles of significant resource or activity.
0.9 - " " " 6.1-7 " " " " " " "
0.8 " " " 7.1-8 " " " " " " "
0.7 " " " 8.1-10 " " " " " " "
0.6 " " " 10.1-12 " " " " " " "
0.5 " " " 12.1-14 " " " " " " "
0.4 " " " 14.1-17 " " " " " " "
0.3 " " " 17.1-20 " " " " " " "
0.2 " " " 20.1-24 " " " " " " "
0.1 " " " 24.1-28 " " " " " " "
0.0 " " " 28.1-up " " " " " " "

b. Structures

The fact that offshore structures generate a different sort of impact or conflict of use than oil spills requires that their proximity to significant resources or activities in the area be evaluated in a different manner. The kinds of impacts structures can cause have been treated in detail elsewhere in this statement. In this evaluation the proximity of structures is viewed as an "either-or" matter. A tract on which structures may be placed either lies within a resource or use area where it can produce an adverse impact, or it lies outside of an area where it can have an impact. The varying distances of tracts from resources or activities do not have the same importance for structures as they do for oil spills.

Based on these assumptions, if a tract is situated so that structures on it may lie within a resource or use area, it is assigned a full proximity value (1) for structures. If the tract is completely outside the resource or use area it is assigned a (0) proximity value for structures.

However, there are two exceptions to this rule. Any tract lying within 5 miles of a seal rookery has been assigned a full proximity value for structures. This is in consideration of the seals' sensitivity to human activity near their breeding grounds. Also, any tract within 20 miles of a shoreline, except that of San Clemente Island, has been assigned a full proximity value (1) for aesthetics. This takes into consideration the visibility of structures from shore. Structures beyond 20 miles from shore are likely to have little or no visual impact on a view from shore.

(See Appendix 17 for the proximity evaluation tables and a brief explanation of how they are used.)

L. Recapitulation of the Proximity Evaluation

1. Refuges/Wildlife Management Areas

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-10, 15-17, 20-26, 29-31, 186-188, 195, 197, 202, 204-208, 210-212, 215, 216, 242-246, 248, 272, 278, 279, 286, 292	50
.9	14, 27, 32, 181, 189, 194, 201,209, 213-214, 217, 218, 222, 247, 249, 251, 271, 285	19
.8	12, 13, 19, 28, 33, 37, 38, 180, 182, 196, 203, 250, 253, 291, 297	15
.7	11, 34-36, 39, 40, 176, 183, 185, 190, 193, 198, 200, 219, 223, 224, 254-256, 258, 259, 264, 270, 277, 283, 284, 296	27
.6	18, 41-46, 175, 177-179, 184, 192, 199, 220, 225, 228, 257, 260-263, 269, 276, 290, 295	26
.5	47, 50, 173, 174, 191, 221, 226, 229, 230, 239, 241, 265, 266, 275, 282, 289, 293	17
.4	48, 49, 51-53, 62-65, 172, 227, 231, 234, 238, 240, 267, 268, 274, 280, 281, 287, 288, 294	23
.3	54-58, 61, 66, 68-71, 232, 233, 235, 236, 273	16
.2	59, 60, 67, 72-77, 237	10
.1	78-82	5
.0	83-171	89

b. Structures

None of the tracts proposed for leasing have a proximity value of (1) for structures, indicating that there will be no offshore structures erected in these resource areas.

2. Kelp Beds

a. Oil Spills

Proximity Value	Tract Number	Total
1.0	1-4, 6-10, 14-17, 20-27, 29-33, 186-188, 197, 204-208, 211-214, 216-221, 233, 236, 237, 239, 241, 245-271, 272, 278, 279, 285, 286, 292	58
.9	5, 13, 19, 28, 181, 182, 189, 210, 222, 223, 227, 232, 238, 246, 247, 250-252, 264, 291, 297	21
.8	12, 34, 36-39, 180, 196, 198, 203, 215, 224-226, 235, 240, 253, 270, 277	19
.7	11, 18, 35, 40, 44, 175-177, 183, 185, 190, 209, 231, 254, 256-259, 263, 276, 284, 290, 296	23
.6	41-43, 45, 46, 178, 179, 184, 191, 199, 228-230, 234, 242, 248, 249, 260, 265, 269, 275, 282, 283, 295	24
.5	47, 49-51, 173, 174, 195, 200, 202, 255, 261, 262, 266, 268, 289, 294	16
.4	48, 52-54, 56, 172, 192, 194, 201, 267, 273, 274, 280, 281, 288, 293	16
.3	55, 57-64, 193, 287	11
.2	65-71	7
.1	72-76, 78	6
.0	77, 79-171, 243, 244	96

b. Structures

None of the tracts proposed for leasing have a proximity value of (1) for structures, indicating that there will be no offshore structures erected in these resource areas.

3. Bird Rookeries

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-10, 13-17, 19-32, 37, 186-189, 195, 197, 202, 204-208, 210-212, 214-221, 227, 232, 233, 236, 237, 239, 241-245, 247-249, 255, 256, 264, 271, 272, 278, 279, 285, 286, 292	77
.9	12, 33, 36, 181, 194, 201, 209, 213, 222, 246, 251, 263, 270	13
.8	34, 38, 180, 182, 193, 196, 203, 223, 226, 231, 238, 240, 250, 252, 254, 262, 277, 291, 297	19
.7	11, 18, 35, 39, 40, 176, 183, 185, 190, 198, 200, 224, 225, 235, 253, 258, 259, 261, 268, 269, 276, 284, 296	23
.6	41-45, 50, 175, 177-179, 184, 192, 199, 228-230, 257, 260, 275, 282, 283, 290, 295	23
.5	46, 47, 173, 174, 191, 234, 265-267, 274, 281, 289	12
.4	48, 49, 51-53, 56, 62-65, 172, 273, 280, 287, 288, 293, 294	17
.3	54, 55, 57-59, 61, 66, 68-71	11
.2	60, 67, 72-77	8
.1	78-83	6
.0	84-171	88

b. Structures

None of the tracts proposed for leasing have a proximity value of (1) for structures, indicating that there will be no offshore structures erected in these resource areas.

4. Seal Rookeries

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-4, 6-9	8
.9	5	1
.8	13, 38	2
.7	10-12, 14, 15	5
.6	18, 19	2
.5	20	1
.4	21, 22, 28, 29, 62, 63	6
.3	30, 36, 61, 64-66, 68, 69	8
.2	23, 24, 31, 32, 37, 67, 70-75	12
.1	25, 26, 33, 39, 40, 44, 45, 50, 76-81, 196, 203, 204	17
.0	16, 17, 27, 34, 35, 41-43, 46-49, 51-60, 82-195, 197-202, 205-297	235

b. Structures

Tracts 1-4, 7, 8, and 9 have a proximity value of (1) for structures, indicating that any structures erected on these tracts could be within five miles of seal rookeries.

5. Rocky Shore: Intertidal Communities

a. Oil Spills

Proximity Values	Tract Number	Total Tracts
1.0	1-4, 6-10, 15-17, 20-26, 30-32, 186-188, 195, 202, 204, 205, 215-217, 233, 236, 237, 239, 241, 243-245, 272, 278, 279, 286, 292	45
.9	5, 13, 14, 27, 29, 33, 189, 194, 197, 201, 214, 222, 246, 251, 264, 271, 285	17
.8	19, 28, 34, 37, 38, 180-182, 193, 212, 218, 223, 232, 238, 250, 252, 270, 277, 291	19
.7	11, 12, 18, 35, 36, 39, 40, 183, 185, 190, 196, 198, 200, 203, 211, 213, 224, 227, 231, 235, 240, 247, 253, 256, 258, 259, 263, 276, 284, 290, 296, 297	32
.6	41-45, 175-179, 184, 199, 208, 219, 221, 226, 228, 229, 234, 242, 248, 254, 257, 260, 269, 282, 283, 295	28
.5	46, 47, 50, 173, 174, 191, 192, 207, 210, 220, 225, 230, 249, 255, 261, 262, 265, 266, 268, 275, 289	21
.4	48, 49, 51-53, 172, 206, 209, 267, 274, 280, 281, 287, 288, 294	15
.3	54-59, 67, 273, 293	9
.2	60-63	4
.1	64, 68	2
.0	65-66, 69-171	105

b. Structures

None of the tracts proposed for leasing have a proximity value of (1) for structures, indicating that there will be no offshore structures erected within these resource areas.

6. Sandy Beach: Intertidal Communities

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-4, 6-10, 15-17, 25, 26, 206-208, 210-212, 214-221, 227, 232, 233, 237, 242, 247-249, 255, 256, 263, 264, 271, 272, 279, 286	44
.9	5, 14, 209, 213, 222, 236, 239, 270, 278, 285, 292	11
.8	20, 21, 27, 223, 226, 241, 246, 254, 262	9
.7	11-13, 19, 22, 32-35, 224, 225, 231, 235, 238, 245, 261, 269, 276, 277, 284, 291, 297	22
.6	18, 23, 28-30, 39-41, 228-230, 240, 244, 252, 260, 267, 268, 275, 283, 290, 296	21
.5	31, 36, 37, 42, 43, 234, 243, 251, 253, 259, 266, 274, 281, 282, 289, 295	16
.4	24, 38, 46-49, 52, 62-65, 250, 257, 258, 265, 273, 280, 287, 288, 294	20
.3	44, 45, 53-55, 61, 66, 68-71, 293	12
.2	50, 51, 57-60, 67, 72-77, 172, 173, 194, 195	17
.1	56, 78-82, 174, 177, 178, 193, 201, 202	12
.0	83-171, 175, 176, 179-192, 196-200, 203-205	113

b. Structures

None of the tracts proposed for leasing have a proximity value of (1) for structures, indicating that no offshore structures will be erected in these resource areas.

7. Aesthetics

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-10, 13-17, 19-33, 37, 186-188, 195, 197, 202, 204-208, 210-212, 214-221, 227, 232, 233, 236, 237, 239, 241-245, 247-249, 255, 256, 264, 271, 272, 278, 279 285, 286, 292	77
.9	12, 36, 181, 189, 194, 201, 209, 213, 222, 246, 251, 263, 270	13
.8	11, 34, 38, 180, 182, 193, 196, 203, 223, 226, 231, 238, 250, 252, 254, 262, 277, 291, 297	19
.7	18, 35, 39, 40, 176, 183, 185, 190, 198, 200, 224, 225, 235, 240, 253, 258, 259, 261, 268, 269, 276, 284, 296	23
.6	41-45, 50, 175, 177-179, 184, 192, 199, 228-230, 257, 260, 275, 282, 283, 290, 295	23
.5	46, 47, 173, 174, 191, 234, 265-267, 274, 281, 289	12
.4	48, 49, 51-53, 56, 172, 273, 280, 287, 288, 293, 294	13
.3	54, 55, 57-59	5
.2	60	1
.1		0
.0	61-171	111

b. Structures

Tracts 1-59, 172-190, and 192-297 have a proximity value of (1) for structures, indicating that any structures erected on these tracts could be within 20 miles from shore.

8. Archeology

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-10, 13-17, 20-27, 29-34, 186-188, 195, 197, 202, 204-222, 226, 227, 231-233, 236, 237, 239, 241-256, 259-264, 266, 268-272, 278-279, 284-286, 292	96
.9	12, 19, 28, 35, 37-39, 181, 189, 194, 196, 201, 203, 223-225, 238, 258, 267, 276, 297	21
.8	11, 36, 40-42, 180, 182, 185, 193, 198, 235, 240, 265, 274, 277, 291	16
.7	18, 43-46, 176, 179, 183, 190, 200, 228-230, 234, 257, 273, 274, 282, 283, 290, 296	21
.6	48, 175, 177, 178, 184, 191, 192, 199, 280, 281, 295	11
.5	47, 49-53, 173, 174, 287-289, 294	12
.4	54-59, 61-66, 172, 293	14
.3	60, 67-72	7
.2	73-79	7
.1	80-83, 85-87	7
.0	84, 88-171	85

b. Structures

Tracts 242, 245-249, 253-256, and 263 have a proximity value of (1) for structures, indicating that part of the tract has a depth of less than 150 feet.

9. Shipping

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	24, 61-72, 73-83, 206-217, 222-224, 228-231, 234-236, 238-270, 273-276, 280-283, 287-289, 293, 294	92
.9	84-90, 128, 225, 237, 277	11
.8	106, 117, 168, 218, 232, 233, 271, 290, 295	9
.7	93-97, 105, 116, 127, 142, 167, 195, 219, 226, 227, 272, 278, 284, 292, 297	19
.6	91, 92, 115, 126, 141, 153, 163, 164, 171, 193, 194, 220, 221, 279, 285, 291, 296	17
.5	98-104, 114, 125, 140, 152, 160, 172, 174, 178, 184, 192, 202, 286	19
.4	107-113, 124, 139, 150, 151, 156, 157, 159, 169, 170, 173, 176, 177, 183, 190, 191, 200, 201,	24
.3	1-3, 5, 6, 11, 16, 17, 118-123, 138, 149, 155, 165, 166, 175, 180-182, 188, 189, 198, 199,	27
.2	4, 7, 12, 13, 18, 19, 25-28, 33, 34, 129-137, 158, 161, 162, 179, 186, 187,	27
.1	8, 9, 10, 14, 15, 20, 29, 31, 32, 35-37, 40-42, 44, 50, 51, 56, 143-148, 154, 185, 197,	28
.0	21-23, 30, 38-39, 43, 45-49, 52-55, 57-60, 196, 203-205	24

b. Structures

Tracts 61-72, 206, 209-211, 213, 228, 234, 238, 240-248, 252-255, 259-262, 267-269, 273-275, 280, 281, 287, 293, have a proximity value of (1) for structures, indicating that any structures erected on these tracts would be in either a commercial shipping lane, a designated submarine lane, or a prohibited dumping area.

10. Outdoor Recreation

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-10, 13-17, 19-41, 172-177, 179-198, 200-297	162
.9	18, 178	2
.8	11, 12, 42, 44, 199	5
.7	43, 45-48, 50	6
.6	49, 51-53	4
.5	54, 55	2
.4	56-60, 62-65	9
.3	61, 66, 68-71	6
.2	67, 72-77	7
.1	78-83	6
.0	84-171	88

b. Structures

Tracts 16, 17, 21-26, 29-31, 173, 175, 180, 186-195, 202, 206-260, 262-272, 274-279, 281-286, 289-292, and 295-297 have a proximity value of (1) for structures, indicating that any structures erected on these tracts would be within an intensive use area.

11. Commercial Fishing

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	100-105, 110-115, 120-126, 134-140, 147-153, 155-157, 159, 160, 163, 164, 184-189, 193-197, 200-205, 214-278, 280-284, 287-290, 293-295	134
.9	93-97, 106, 116, 178-182, 198, 212, 213	15
.8	133, 146, 154, 158, 183, 190-192	8
.7	86-90, 117, 127, 141, 167, 168, 175-177, 199, 208, 211, 279, 285, 291, 296	20
.6	85, 109, 119, 128, 132, 142, 145, 292, 297	9
.5	79-83, 108, 118, 131, 173, 174, 207, 210, 286	13
.4	75-78, 99, 107, 144, 172, 206, 209	10
.3	70-74, 92, 98, 130, 143, 162, 166	11
.2	62-69, 84, 91, 129, 161, 165, 169, 170	15
.1	61, 171	2
.0	1-60	60

b. Structures

Tracts 111-114, 121-124, 135-138, 148-151, 155-157, 197, 204, 205, 215, 232, 234-241, 243-270, 273-276, 280-282, 287, 288, and 293 have a proximity value of (1) for structures, indicating that any structures erected on these tracts would be within a 10 million pound per year catch block as defined by the California Department of Fish and Game.

12. Sport Fishing

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-10, 13-17, 19-32, 37, 186-189, 195, 197, 202, 204-208, 210-212, 214-221, 227, 232, 233, 236, 237, 239, 241-245, 247-249, 255, 256, 264, 271, 272, 278, 279, 285, 286, 292	77
.9	12, 33, 181, 194, 201, 209, 213, 222, 246, 251, 263, 270	12
.8	11, 34, 36, 38, 180, 182, 193, 196, 203, 223, 226, 231, 238, 240, 250, 252, 254, 262, 277, 291, 297	21
.7	18, 35, 39, 40, 176, 183, 185, 190, 198, 200, 224, 225, 235, 253, 258, 259, 261, 268, 269, 276, 284, 296	22
.6	41-45, 50, 175, 177-179, 184, 192, 199, 228-230, 257, 260, 275, 282, 283, 290, 295	23
.5	46, 47, 173, 174, 191, 234, 265-267, 274, 281, 289	12
.4	48, 49, 51-53, 56, 62-65, 172, 273, 280, 287, 288, 293, 294	17
.3	54, 55, 57-59, 61, 66, 68-71	11
.2	60, 67, 72-77	8
.1	78-83	6
.0	84-171	88

b. Structures

None of the tracts proposed for leasing have a proximity value of (1) for structures, indicating that there will be no offshore structures erected in these resource areas.

13. Military Uses

a. Oil Spills

Proximity Value	Tract Number	Total Tracts
1.0	1-132, 134-142, 147-160, 163, 164, 166-176, 179-211	201
.9	133, 143	2
.8	144, 146, 162, 165, 177, 212, 213	7
.7	145, 161	2
.6	178, 214, 293-295	5
.5	215, 287-289, 296, 297	6
.4	240, 241, 250, 257, 273, 280-283, 290-292	12
.3	216, 217, 222, 238, 239, 243, 251, 258, 265, 266, 267, 274-277, 284-286	18
.2	218, 223, 224, 228, 234-237, 244, 245, 252, 259-262, 268-272, 278, 279	22
.1	219, 229-233, 246, 253-256	11
.0	220, 221, 225, 226, 227, 242, 247-249, 263, 264	11

b. Structures

Tracts 1-89, 91-94, 98-101, 105-109, 114-117, 123-128, 136-142, 148-153, 155-157, 159-160, 163, 164, 167, 168, 179, 185, 196-207, 209, and 210 have a proximity value of (1) for structures, indicating that any structures erected on these tracts would be within a missile test range or a fleet maneuver area.

M. Summary Risk Analysis

All tracts proposed for leasing in this sale are evaluated according to the relative potential degree of hazard they pose to the environment and the amount of disruption or degradation potential they pose to other multiple-use activities and aesthetics in the area. Although largely a subjective analysis, this evaluation is based on the detailed environmental analysis presented in previous sections of this statement, on our understanding of the industry's current technological capabilities, on the proximity evaluation in sections K and L, and on the matrix tables in the appendix. See Graphic 15 for a visual display of the impacts from this analysis and also the tract numbers.

Although the probabability of a 1000 bbl. or more oil spill occurring from any tract is considered low (less than one per 1000 wells drilled), for purposes of analysis we are assuming that a 1000 bbl. oil spill has occurred from each tract and the slick is moving in the direction of the nearest resource area. In addition, although the probability that a structure will be erected on any tract leased is 1:3, we are assuming for this analysis that every tract offered will have a structure erected on it. Even though we know this will not occur, we make this assumption because we have no way of knowing which tracts will lease and which of those that do lease will eventually be the site for a fixed structure.

1. Relatively High Hazard Potential

All tracts with an oil spill proximity value of (1.0) for one or more of the following categories are considered to have relatively high hazard potential: Refuges/Wildlife Management Areas, Kelp Beds, Bird Rookeries, Seal Rookeries, Rocky Shore - Intertidal Communities, and Sandy Beach - Intertidal Communities. They are so considered because of the nature of the impact an oil spill could have on these resources, and because their proximity would disallow the minimum practical response time (12 hours) necessary for oil spill constraint and clean-up measures to prevent such an impact. A total of 81 tracts are considered to have a relatively high hazard potential. (See list in Section M.4 below).

2. Relatively High Disruption Potential

The following criteria have been used to determine which tracts are considered to have a relatively high potential for being disruptive to cultural values or multiple-use activities of the area: any tract having a structure proximity value of (1) for archeology, shipping, or commercial fishing; and, any tract having an oil spill proximity value of (1.0) for outdoor recreation, commercial fishing, or sport fishing.

A total of 217 tracts, meet the criteria outlined above: (See list in Section M.4 below).

3. Relatively High Aesthetic Degradation Potential

All tracts with an oil spill proximity value of (1.0) or a structure proximity value of (1) for aesthetics are considered to have a relatively high potential for degrading the aesthetic quality of the view from a particular shoreline. The severity of this impact will of course vary with the observer, the size and persistence of the oil spill, (should one occur) and the distance from shore of the particular tract. However, although the impact on aesthetic quality is extremely difficult to quantify, a total of 185 tracts merit special mention regarding their effect on aesthetic values. (See list in Section M.4 below.)

4. Impact Potential by Tract

The following list includes all tracts (249) which are considered to have a relatively high potential for the types of environmental impacts outlined in sections 1, 2, and 3 above. The reason or reasons for each tract being so considered are indicated by the letters a, b, or c after each tract number.

a. Relatively High Hazard Potential
b. Relatively High Disruption Potential
c. Relatively High Potential for Aesthetic Degradation

Tract No.	
1	a, b, c
2	a, b, c
3	a, b, c
4	a, b, c
5	a, b, c
6	a, b, c
7	a, b, c
8	a, b, c
9	a, b, c
10	a, b, c
11	c
12	c
13	a, b, c
14	a, b, c
15	a, b, c
16	a, b, c
17	a, b, c
18	c
19	a, b, c
20	a, b, c
21	a, b, c
22	a, b, c
23	a, b, c
24	a, b, c
25	a, b, c
26	a, b, c
27	a, b, c
28	a, b, c
29	a, b, c
30	a, b, c
31	a, b, c
32	a, b, c
33	a, b, c
34	b, c
35	b, c
36	b, c
37	a, b, c
38	b, c
39	b, c
40	b, c
41	b, c
42	c
43	c
44	c
45	c
46	c

Tract No.	
47	c
48	c
49	c
50	c
51	c
52	c
53	c
54	c
55	c
56	c
57	c
58	c
59	c
61	b
62	b
63	b
64	b
65	b
66	b
67	b
68	b
69	b
70	b
71	b
72	b
73	b
74	b
75	b
76	b
77	b
78	b
79	b
80	b
81	b
82	b
83	b
100	b
101	b
102	b
103	b
104	b
105	b
110	b
111	b
112	b

Tract No.	
113	b
114	b
115	b
120	b
121	b
122	b
123	b
124	b
125	b
126	b
134	b
135	b
136	b
137	b
138	b
139	b
140	b
147	b
148	b
149	b
150	b
151	b
152	b
153	b
155	b
156	b
157	b
159	b
160	b
163	b
164	b
172	b, c
173	b, c
174	b, c
175	b, c
176	b, c
177	b, c
178	c
179	b, c
180	b, c
181	b, c
182	b, c
183	b, c
184	b, c

Tract No.

185 b, c
186 a, b, c
187 a, b, c
188 a, b, c
189 a, b, c
190 b, c
191 b, c
192 b, c
193 b, c
194 b, c
195 a, b, c
196 b, c
197 a, b, c
198 b, c
199 c
200 b, c
201 b, c
202 a, b, c
203 b, c
204 a, b, c
205 a, b, c
206 a, b, c
207 a, b, c
208 a, b, c
209 b, c
210 a, b, c
211 a, b, c
212 a, b, c
213 a, b, c
214 a, b, c
215 a, b, c
216 a, b, c
217 a, b, c
218 a, b, c
219 a, b, c
220 a, b, c
221 a, b, c
222 b, c
223 b, c
224 b, c
225 b, c
226 b, c
227 a, b, c
228 b, c
229 b, c
230 b, c

Tract No.

231 b, c
232 a,b, c
233 a, b, c
234 b, c
235 b, c
236 a, b, c
237 a, b, c
238 b, c
239 a, b, c
240 b, c
241 a, b, c
242 a, b, c
243 a, b, c
244 a, b, c
245 a, b, c
246 a, b, c
247 a, b, c
248 a, b, c
249 a, b, c
250 b, c
251 b, c
252 b, c
253 b, c
254 b, c
255 a, b, c
256 a, b, c
257 b, c
258 b, c
259 b, c
260 b, c
261 b, c
262 b, c
263 a, b, c
264 a, b, c
265 b, c
266 b, c
267 b, c
268 b, c
267 b, c
268 b, c
269 b, c
270 b, c
271 a, b, c
272 a, b, c
273 b, c
274 b, c

Tract No.

275 b, c
276 b, c
277 b, c
278 a, b, c
279 a, b, c
280 b, c
281 b, c
282 b, c
283 b, c
284 b, c
285 a, b, c
286 a, b, c
287 b, c
288 b, c
289 b, c
290 b, c
291 b, c
292 a, b, c
293 b, c
294 b, c
295 b, c
296 b, c
297 b, c

It is apparent from this list that a number of tracts have a relatively high potential for causing more than one type of environmental impact. There are 81 tracts which are considered to have high potential for all three types of impacts (a, b, and c) listed above. There are 83 tracts which have a high potential for two types of impacts (b and c above), and 85 tracts are considered to have a high potential for causing one type of impact (63 relative to b above and 22 relative to c above).

N. Possible Cumulative Impacts of Proposed OCS Lease Sale No. 35 and Other Major Federal Actions

In addition to the proposed OCS lease sale, No. 35, there are a number of other proposed major federal actions in the Southern California area which if implemented could result in cumulative impacts on various environmental and socio-economic factors. These projects include: tanker delivery of Alaskan north slope oil; continued importation of foreign crude oil; delivery of liquefied natural gas (LNG); future OCS sales; expanded development of the Santa Barbara Channel; deepwater ports; a proposed refinery and marine terminal near Carlsbad; and possible nuclear power plants along the coast.

Development of Alaska's north slope reserves could result in the arrival of 1,200,000 bbls of crude oil on the west coast by 1978, with an anticipated increase in delivery to a level of two million bpd by 1985. It is projected that 20 tankers with a deadweight tonnage of 1,390,000 tons and a turnaround time of 14.5 to 15.5 days will be required to transport the initial crude from Alaska to the Los Angeles area. Foreign imports, via tankers, from Indonesia are expected to continue because Indonesian oil has a lower sulfur content than domestic crude and is required for mixing with domestic crude for certain processing, and direct burning in boilers. Tanker transport of LNG from either domestic and/or foreign sources is proposed with terminal facilities planned for Point Conception, Oxnard, and Los Angeles harbor. Each of these proposed facilities would be capable of receiving LNG for a base load vaporization rate of 4 billion cubic feet of natural gas per day at full capacity. Possible future OCS sales No's. 48 and 53 presently scheduled for June 1977 and April 1978 respectively, would also affect the offshore California area.

The size and exact location of these possible sales is as yet unknown. Expanded development of Federal OCS tracts in the Santa Barbara Channel could result in 10-21 offshore platforms, 1-5 onshore facilities, 1-6 pipelines, and 190-520 development wells. Two deepwater ports are proposed for Los Angeles and Long Beach harbors to accommodate large oil tankers. One of these proposed ports could be used to offload Alaskan crude for pipeline transport to the mid-west. The proposed refinery and marine terminal near Carlsbad could be utilized to handle increased oil supplies resulting from the above mentioned projects. Additional electrical power demands could also result in further development of previously proposed nuclear power plants along the Southern California coast.

The projects involving tanker transport of crude oil would result in increased collision and spillage probabilities. The impacts of large spills would be similar to those described in Section III of the EIS. However, the effects of chronic low level spillage, and the effect of possible reduced recovery time between major spills is as yet unknown, but could be more serious than large spills themselves.

The tanker transport of LNG would again increase shipping traffic and would tend to create even more congestion in port areas due to the fact that, for safety purposes, all other ship traffic within a harbor is halted while a loaded LNG ship is in the immediate area. Collision and resultant spillage of LNG would create a significant safety problem due to the highly flammable nature of LNG and the rapid spreading potential of the LNG plume cloud over water.

The above mentioned tanker projects lead directly to the requirement for the proposed deepwater ports and marine loading terminals. These proposed port facilities would result in dredging operations and use of onshore lands. Dredging creates temporary impacts to water quality by increasing heavy metal and pesticide concentrations through resuspension of bottom sediments. Benthic organisms in the immediate vicinity of dredging are affected by both direct mechanical removal and loss through smothering. However, this impact is usually temporary and restricted to a small area. The combined effects of chronic low level oil pollution and the resuspension of heavy metals and other toxic elements, as a result of dredging, are also not well understood but could create significant impacts on food chains and productivity of the biotic community.

The onshore use of land for marine terminals would require only small portions of land, but because of the location along the coast, marshlands or other valuable areas could possibly be affected.

The onshore terminals and proposed refinery could also affect air quality during construction stages, and the refinery would emit odorous gases during its production life. (See Section III.N. for discussion of refinery impacts).

The potential Santa Barbara lease development and possible future OCS sales would again increase the probability of oil pollution and would also create aesthetic impact due to offshore platform placement. Resultant pipelines which come onshore would remove various acreages of land for use as rights-of-way. This impact would vary considerably depending on the types of areas crossed. Industrial areas, roadways and other already developed areas would receive minor alteration. However, marshes or other unique areas could be significantly affected due to alteration in vegetation and drainage patterns.

The possible nuclear plants would remove certain acreages of land, could cause thermal pollution of nearby waters due to cooling water discharge, and would create radioactive waste products which have a high pollution potential.

On the positive side, the increased activity would help to create additional employment, directly and also indirectly, in the service and trade sectors. This would help to not only relieve unemployment in the area, but also the resultant pressures applied to various government welfare agencies as a result. The positive economic benefits could be significant.

A study completed in June 1973 called "Environmental Assessment West Coast Deepwater Port Study" analyzed the potential development of 11 deepwater port sites through the use of approximately 40 scenarios and assessed the impacts from each. This study will be discussed here for an insight into possible cumulative impacts in the Southern California area. This study was completed by Battelle Pacific Northwest Laboratories for the U. S. Army Engineer District in San Francisco and summarized existing environmental conditions for potential deepwater port sites on the West Coast of the United States. Environmental assessments were also conducted relating to increased movement of conventionally sized oil tankers which would not necessitate deepwater port developments. These were compared with environmental changes which would result from the development of deepwater ports to handle larger but fewer oil tankers. Both development conditions were evaluated for projected crude oil demands on the West Coast in the years 1980 and 2000. The environmental analyses considered the impact of oil tanker operation (including oil spills), the construction and maintenance of navigation channels, and the construction and operation of terminals, pipelines, refineries and other support facilities on air quality, water quality, flora and fauna, aesthetics, recreation, and archeological and historical values. The assessments were presented in matrix form backed by brief narrative statements. Secondary effects of superport development such as impacts on land use, economics, transportation, social and political processes were not considered in this study.

Although the overall study conducted by the Corps of Engineers encompasses the entire West Coast, the scope of services conducted by Battelle-Northwest was limited to environmental assessments of potential deepwater port sites located in the vicinity of the existing West Coast refinery complexes in the Puget Sound, San Francisco Bay area and Southern California regions. For our purposes we will present the Environmental Interaction Matrices as well as the Environmental Assessment Matrices for areas in Southern California only, which includes:

1) Los Angeles Harbor, California
2) Long Beach Harbor, California
3) Offshore Point Fermin, California
4) Offshore Port Hueneme, California
5) Offshore Encina, California

The interaction matrices (See Tables III-37 - 50) through the use of brief statements analyzes the interweave of anticipated impacts between related activities for each development alternative of each site. These matrices generally considered only the normal construction, maintenance and operation of each component within the framework of each action. The assessment matrices evaluate the impact on individual resource catagories for each potential development scenario as a whole. The comparison is with the base case - "Without Supertankers, 1980".

One Environmental Assessment Matrix is presented for each site in Southern California. The following numerical values indicated relative magnitudes of positive or negative environmental differences from the base case. These values consider primarily long term and repetitive consequences.

-2 highly negative effect
-1 moderately negative effect
0 little or no effect
+1 moderately positive effect
+2 highly positive effect

compared to "Without Supertankers - 1980" effects

Assessments of air quality for both the interaction and assessment matrices were based on the following:

primary pollutants	- sulfur oxides, nitric oxides, hydrocarbons, carbon monoxide and oxidants;
secondary pollutants	- fluoride, lead, sulfuric acid mist, cadmium, etc;
odor causing pollutants	- hydrogen sulfide, ammonia, mercaptans, etc;
visibility	suspended particulates, smoke, etc. that restrict visibility; and
microclimate	- local air temperature, humidity, wind and precipitation..

In addition,this publication assessed the need for new refineries and their potential sites to meet increased demands in the year 2000. It was assumed that existing refineries could expand sufficiently at their present locations to meet demands in the year 2000. In Southern California this report anticipates new refinery construction in Antelope

Valley which is north of the Los Angeles Air Basin.

In summary, the combined impacts possibly resulting from the presently proposed OCS Sale (No. 35) and the above mentioned projects could result in significant effects on the water quality and biota of the Southern California coastal area. These cumulative impacts could be further compounded in areas presently under environmental stress from pollution due to agricultural run off, effluent discharges, natural oil seeps, and ocean dumping.

Therefore, it is imperative that all proposed projects be carefully analyzed as to their possible impacts, with particular attention given to the mitigating measures proposed by each, to reduce or eliminate cumulative impacts.

These projects are all still in the planning or proposal stages and as yet site specific environmental impact statements, which will pinpoint the impacts of each project, have not been completed. Therefore, the specifics of the environmental and socio-economic impacts are not yet available and were only described in general terms.

TABLE III-37
ENVIRONMENTAL INTERACTION MATRIX

LOCATION: LOS ANGELES/LONGBEACH HARBOR, CALIFORNIA

CONDITION: WITHOUT SUPERTANKERS - 1980

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Little impact from ship activity	NA	Location of disposal site is poor from odor viewpoint	Minor emissions	HC emissions	Controls necessary to limit release of organics	Permits for expansion of refineries may depend upon local air quality in 1980
WATER QUALITY	Decrease due to surface oil and grease	NA	Pollutant releases and turbidity during maintenance dredging	Decrease due to surface oil and grease, pollutant releases and turbidity during berth expansion	NSI	Silt runoff during construction, high earthquake damage potential	Silt runoff during construction, additional effluent loads on city sewer systems
FLORA	NSI except from major casualty spill	NA	Turbidity would reduce productivity	NSI	NSI	NSI	NSI
FAUNA	NSI except from major casualty spill	NA	Maintenance dredging would remove some organisms	NSI	NSI	NSI	NSI
AESTHETICS	Visual impairment by oil spill, noise during cleanup	NA	Turbidity during maintenance dredging, visual and odor effects from spoil disposal	Turbidity from berth expansion, noise from spill cleanup, occasional olfactory effects	NSI	Moderate visual effects, loss of open space, construction noise, olfactory effects	
RECREATION	Spatial interference with boating, oil spill damage to shoreline and pleasure boats	NA	NSI	Oil spill damage to shoreline and pleasure boats	NSI	NSI	NSI
ARCHEOLOGICAL	The Point Fermin lighthouse area could suffer oil spill damage	NA	NSI	NSI	NSI	NSI	NSI

Source: "Environmental Assessment West Coast Deepwater Port Study," June 1973, Battelle Pacific Northwest Laboratories

TABLE III-38

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: LOS ANGELES/LONG BEACH HARBOR, CALIFORNIA

CONDITION: WITHOUT SUPERTANKERS - 2000

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Ships may add to air pollution	NA	Pollution during construction	Minor emissions	Some air pollution from construction and operations	New tank farms would be additional sources for organics	New refinery would not effect the L.A. air basin but contribute to air pollution north of L.A.
WATER QUALITY	Decrease due to surface oil and grease	NA	Pollutant releases and turbidity during maintenance dredging	Decrease due to surface oil and grease, pollutants releases and turbidity during berth expansion	Silt runoff during construction, high earthquake damage potential, spill could damage groundwater recharge basins	Silt runoff during construction, high earthquake damage potential	Potential groundwater impairment in Antelope Valley
FLORA	NSI except from major casualty spill	NA	Turbidity would reduce the productivity	NSI	NSI	NSI	NSI
FAUNA	NSI except from major casualty spill	NA	Maintenance dredging would remove some organisms	NSI	NSI	NSI	NSI
AESTHETICS	Visual impairment by oil spills, noise during cleanup	NA	Turbidity during maintenance dredging, visual and odor effects from spoil disposal	Turbidity during berth expansion, noise from spill cleanup, occasional olfactory effects	Adverse visual, dust, and traffic effects, flora lost	Adverse visual effect from new facilities, loss of open space, construction noise and dust, occasional olfactory effects	
RECREATION	Spatial interference with boating, oil spill damage to shoreline and pleasure boats	NA	NSI	Oil spill damage to shoreline and pleasure boats	Adverse effects on trails and picnic areas	NSI	NSI
ARCHEOLOGICAL	The Point Fermin lighthouse area could suffer oil spill damage	NA	NSI	NSI	May cross archeological values	NSI	NSI

Source: "Environmental Assessment West Coast Deepwater Port Study," July 1973, Battelle Pacific Northwest Laboratories

TABLE III-39

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: LOS ANGELES/LONG BEACH HARBOR, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 1980

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Little impact from ship activity	NA	Pollution during expansion	Minor emissions	HC emissions	Controls necessary to limit release of organics	Same as "Without Supertankers - 1980"
WATER QUALITY	Decrease due to surface oil and grease	NA	Pollutant release and turbidity during new dredging and leaching from landfill	Decrease due to surface oil and grease, some turbidity during construction of offshore mooring pier	Pollutants release and turbidity during dredging for underwater pipeline	Silt runoff during construction, high earthquake damage potential	
FLORA	NSI except from major casualty spill	NA	Dredging would reduce productivity and degrade ecosystem	NSI	NSI	NSI	
FAUNA	NSI except from major casualty soill	NA	Dredging would harm some organisms, landfill would displace anchovies	NSI	NSI	NSI	
AESTHETICS	Visual impairment by oil spill, noise during cleanup	NA	Turbidity during new and maintenance dredging, visual and odor effects from spoil disposal	Minor turbidity during construction	Turbidity during pipeline dredging	Land lost from open area, construction noise	
RECREATION	Spatial interference with boating, oil spill damage to shoreline and pleasure boats	NA	Spoil landfill would reduce outer harbor water area	Oil spill damage to shoreline and pleasure boats	Underwater pipeline construction would be an inconvenience to boats	NSI	
ARCHEOLOGICAL	The Point Fermin lighthouse area could suffer oil spill damage	NA	NSI	NSI	NSI	NSI	

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-40

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: LOS ANGELES/LONG BEACH HARBOR, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 2000

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Potential for air Pollution increased	NA	NSI	NSI	Same as "Without Supertankers - 2000 plus potential environmental impacts of underwater pipeline from outer harbor piers to shore		
WATER QUALITY	Decrease due to surface oil and grease	NA	Pollutant release and turbility during maintenance dredging and leaching from landfill	Decrease due to surface oil and grease, some turbidity during expansion of offshore mooring piers			
FLORA	NSI except from major casualty spill	NA	Dredging would reduce productivity and degrade ecosystem	NSI			
FAUNA	NSI except from major casualty spill	NA	Dredging would harm some organisms, landfill would displace anchovies	NSI			
AESTHETICS	Visual impairment by oil spills, noise during cleanup	NA	Turbidity during maintenance dredging, visual and odor effects from spoil disposal	Minor turbidity during expansion			
RECREATION	Spatial interference with boating, oil spill damage to shoreline and pleasure boats	NA	Landfill expansion would reduce outer harbor water area	Oil spill damage to shoreline and pleasure boats			
ARCHEOLOGICAL	The Point Fermin lighthouse area could suffer oil spill damage	NA	NSI	NSI			

Source: "Environmental Assessment West Coast Deepwater Port Study", Juny 1973, Battelle Pacific Northwest Laboratories

TABLE III-41
ENVIRONMENTAL INTERACTION MATRIX

LOCATION: OFFSHORE POINT FERMIN, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 1980

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Little impact from ship activity	NA	NA	NSI	Some HC emissions from land operations	Same as "With Supertankers - 1980" for Los Angeles/Long Beach Harbor Sites	
WATER QUALITY	Decrease due to surface oil and grease	NA	NA	Decrease due to surface oil and grease	Pollutant releases and turbidity during underwater pipeline construction, high earthquake damage potential		
FLORA	NSI except from major casualty spill	NA	NA	Loss of Point Fermin marine life refuge	Pipeline spill could damage offshore and LA/LB Harbor species		
FAUNA	NSI except from major casualty spill	NA	NA	Loss of Point Fermin marine life refuge	Pipeline spill could damage offshore and LA/LB Harbor species		
AESTHETICS	Moderately adverse visual effects, unsightly shorelines from oil spills, noise during cleanup	NA	NA	Distant enough to reduce adverse effects except from oil spills	Visual intrusions during construction, pipeline spill would decrease scenic shoreline		
RECREATION	Little interference except from oil spills, ample room for boats to avoid tankers	NA	NA	Little interference except from oil spills	Pipeline spill could damage popular bathing beaches		
ARCHEOLOGICAL	Oil spill may adversely affect Point Fermin Lighthouse area	NA	NA	NSI	NSI		

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-42

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: OFFSHORE POINT FERMIN, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 2000

NA - Not Applicable

NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Ships would add to air pollution	NA	NA	NSI	HC emissions from land operations	Same as "With Supertankers - 2000" for Los Angeles/Long Beach Harbor Sites	
WATER QUALITY	Decrease due to surface oil and grease	NA	NA	Decrease due to surface oil and grease	Decrease with pipeline spill		
FLORA	NSI except from major casualty spill	NA	NA	Loss of Point Fermin marine life refuge	Pipeline spill could damage offshore and LA/LB Harbor species		
FAUNA	NSI except from major casualty spill	NA	NA	Loss of Point Fermin marine life refuge	Pipeline spill could damage offshore and LA/LB Harbor species		
AESTHETICS	Moderately adverse visual effects, unsightly shorelines from oil spills, noise during cleanup	NA	NA	Distant enough to reduce adverse effects except from oil spills	Pipeline spill would degrade scenic shoreline		
RECREATION	Little interfence except from oil spills, ample room for boats to avoid tankers	NA	NA	Little interference except from oil spills	Pipeline spill could damage popular bathing beaches		
ARCHEOLOGICAL	Oil spill may adversely affect Point Fermin Lighthouse area	NA	NA	NSI	NSI		

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-43

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: OFFSHORE PORT HUENEME, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 1980

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	No significant air pollution	NA	NA	NSI	Emissions during construction and operation	Emissions during construction and operation, effect on microclimate	Same as "Without Supertankers" for Los Angeles/Long Beach Harbor Sites
WATER QUALITY	Decrease due to surface oil and grease	NA	NA	Decrease due to surface oil and grease	Impairment during underwater and overland construction, high earthquake damage potential	Silt runoff during construction, high earthquake damage potential	
FLORA	NSI	NA	NA	NSI	Minor disturbance of terrestrial plants	Loss of some grasslands and agricultural lands	
FAUNA	NSI	NA	NA	NSI	NSI	NSI	
AESTHETICS	Moderately adverse visual effects, unsightly shorelines from oil spills, noise during cleanup	NA	NA	Distant enough to reduce adverse effects except from oil spills	Visual and noise intrusions during construction, pipeline spill would impair scenic values	Visual and noise intrusions during construction	
RECREATION	Little interference except from oil spills, ample room for boats to avoid tankers	NA	NA	Little interference except from oil spills	Some encroachment on trails and picnic areas	NSI	
ARCHEOLOGICAL	NSI	NA	NA	NSI	May cross archeological values	NSI	

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-44

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: OFFSHORE PORT HUENEME, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 2000

NA - Not Applicable
NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Ships would add to air pollution	NA	NA	NSI	Emissions during construction and operation	Emissions during construction and operation, effect on microclimate	Same as "Without Supertankers - 2000" for Los Angeles/Long Beach Harbor Sites
WATER QUALITY	Decrease due to surface oil and grease	NA	NA	Decrease due to surface oil and grease	Silt runoff during construction, high earthquake damage potential	Silt runoff during expansion	
FLORA	NSI except from major casualty spill	NA	NA	NSI	Minor disturbance of terrestrial plants	Loss of some grasslands and agricultural lands	
FAUNA	NSI except from major casualty spill	NA	NA	NSI	NSI	NSI	
AESTHETICS	Moderately adverse visual effects, unsightly shorelines from oil spills, noise during cleanup	NA	NA	Distant enough to reduce adverse effects except from oil spills	Visual and noise intrusions during overland construction	NSI	
RECREATION	Little interference except from oil spills, ample room for boats to avoid tankers	NA	NA	Little interference except from oil spills	Some encroachment on trails and picnic areas	NSI	
ARCHEOLOGICAL	NSI	NA	NA	NSI	May cross archeological values	NSI	

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-45

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: OFFSHORE ENCINA, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 1980

NA - Not Applicable

NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	No significant air pollution	NA	NA	NSI	Emissions during construction and operation	Emissions during construction and operation, effect on microclimate	Same as "Without Supertankers - 1980" for Los Angeles/Long Beach Harbor Sites
WATER QUALITY	Decrease due to surface oil and grease	NA	NA	Decrease due to surface oil and grease	Impairment during underwater and overland construction, high earthquake damage potential	Silt runoff during construction, high earthquake damage potential	
FLORA	NSI except from major casualty spill	NA	NA	NSI	Disruption of some grass lands and several small coastal marshes	NSI	
FAUNA	NSI eacept from major casualty spill	NA	NA	NSI	Disruption of birds and organisms associated with several coastal marshes and inlets	NSI	
AESTHETICS	Moderately adverse visual effects, unsightly shorelines from oil spills, noise during cleanup	NA	NA	Distant enough to reduce adverse effects except from oil spills	Visual and noise intrusions during overland construction, pipeline spill would impair scenic values	Dust, other visual intrusions and noise during construction	
RECREATION	Little interference eacept from oil spills, ample room for boats to avoid tankers	NA	NA	Little interference eacept from oil spills	Pipeline spill could damage popular bathing beaches	NSI	
ARCHEOLOGICAL	NSI	NA	NA	NSI	May cross archeological values	NSI	

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-46

ENVIRONMENTAL INTERACTION MATRIX

LOCATION: OFFSHORE ENCINA, CALIFORNIA

CONDITION: WITH SUPERTANKERS - 2000

NA - Not Applicable

NSI - No Significant Impact

	TANKERS	LIGHTERS	CHANNELS	TERMINALS	PIPELINES	SUPPORT FACILITIES	REFINERIES
AIR QUALITY	Ships would add to air pollution	NA	NA	NSI	Emissions during construction and operation	Emissions during expansion and operation, effect on micro-climate	Same as "Without Supertankers - 2000" for Los Angeles/Long Beach Sites
WATER QUALITY	Decrease due to surface oil and grease	NA	NA	Decrease due to surface oil and grease	Silt runoff during construction, high earthquake damage potential	Turbidity from construction silt	
FLORA	NSI except from major casualty spill	NA	NA	NSI	Disruption of some grasslands and few small coastal marshes	NSI	
FAUNA	NSI except from major casualty spill	NA	NA	NSI	Disruption of birds and organisms associated with few coastal marshes and inlets	NSI	
AESTHETICS	Moderately adverse visual effects, unsightly shorelines from oil spills, noise during cleanup	NA	NA	Distant enough to reduce adverse effects except from oil spills	Visual and noise intrusions during overland construction, pipeline spill would impair scenic values	Flora loss	
RECREATION	Little interference exceot from oil spills, ample room for boats to avoid tankers	NA	NA	Little interference except from oil spills	Some encroachment on trails and picnic areas	NSI	
ARCHEOLOGICAL	NSI	NA	NA	NSI	May cross archeological values	NSI	

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-47
ENVIRONMENTAL ASSESSMENT MATRIX

LOCATION: LOS ANGELES/LONG BEACH HARBOR, CALIFORNIA

ENVIRONMENTAL RESOURCE CATEGORIES		SECT. NO.	POTENTIAL DEVELOPMENTS		
			WITHOUT SUPER-TANKERS 2000	WITH SUPER-TANKERS 1980	WITH SUPER-TANKERS 2000
PHYSICAL AND CHEMICAL	AIR QUALITY	7.2.2			
	PRIMARY POLLUTANTS	7.3.2	-1	0	-1
	SECONDARY POLLUTANTS	"	0	0	0
	ODOR CAUSING POLLUTANTS	"	0	0	0
	VISIBILITY	"	0	0	0
	MICROCLIMATE	"	0	0	0
	WATER QUALITY	7.2.3			
	DISSOLVED AND SUSPENDED SOLIDS	7.3.3	-2	-1	-2
	FLOATING OIL AND GREASE	"	-2	+1	0
	TOXICITY	7.3.5	-2	+1	0
BIOLOGICAL	FLORA	7.2.4			
	TERRESTRIAL PLANTS	7.3.4	0	0	0
	RARE TERRESTRIAL PLANTS	"	0	0	0
	AQUATIC PLANTS	"	-1	+1	0
	RARE AQUATIC PLANTS	"	0	0	0
	FAUNA	7.2.5			
	TERRESTRIAL ANIMALS	7.3.5	0	0	0
	RARE TERRESTRIAL ANIMALS	"	0	0	0
	WATER BIRDS	"	-1	0	-1
	COMMERCIAL FISH AND SHELLFISH	"	-1	-2	-2
	SPORT FISH AND SHELLFISH	"	-1	-2	-2
	OTHER FISH AND SHELLFISH	"	-1	0	0
	MARINE MAMMALS	"	0	0	0
CULTURAL	AESTHETICS	7.2.6			
	VISUAL - AIR QUALITY	7.3.6	0	0	0
	VISUAL - WATER QUALITY	"	-1	+1	0
	VISUAL - FLORA	"	-2	0	-2
	VISUAL - FAUNA	"	-1	+1	0
	VISUAL - SHIPS AND STRUCTURES	"	-1	+1	0
	OPEN SPACE QUALITIES	"	-1	0	-1
	NOISE	"	-2	0	-1
	OLFACTORY	"	-2	0	-1
	RECREATION	7.2.7			
	HUNTING	7.3.7	0	0	0
	FISHING	"	0	+1	+1
	BOATING	"	-1	+1	-1
	SWIMMING	"	-1	+1	0
	PICNICKING, CAMPING AND HIKING	"	-1	0	-1
	SIGHTSEEING	"	0	0	0
	ARCHEOLOGICAL	7.2.8			
	ARCHEOLOGICAL SITES	7.3.8	0	0	0
	HISTORICAL SITES AND MONUMENTS	"	-1	0	-1

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-48
ENVIRONMENTAL ASSESSMENT MATRIX

LOCATION: OFFSHORE POINT FERMIN, CALIFORNIA

	ENVIRONMENTAL RESOURCE CATEGORIES	SECT. NO.	POTENTIAL DEVELOPMENTS		
			WITHOUT SUPER-TANKERS 2000	WITH SUPER-TANKERS 1980	WITH SUPER-TANKERS 2000
PHYSICAL AND CHEMICAL	AIR QUALITY	7.2.2			
	PRIMARY POLLUTANTS	7.4.2		-1	-1
	SECONDARY POLLUTANTS	"		0	0
	ODOR CAUSING POLLUTANTS	"		-1	-1
	VISIBILITY	"		-1	-1
	MICROCLIMATE	"		-1	-1
	WATER QUALITY	7.2.3			
	DISSOLVED AND SUSPENDED SOLIDS	7.4.3		-1	-2
	FLOATING OIL AND GREASE	"		-1	-2
	TOXICITY	7.4.5		-1	-2
BIOLOGICAL	FLORA	7.2.4			
	TERRESTRIAL PLANTS	7.4.4		0	-1
	RARE TERRESTRIAL PLANTS	"		0	0
	AQUATIC PLANTS	"		-1	-1
	RARE AQUATIC PLANTS	"		0	0
	FAUNA	7.2.5			
	TERRESTRIAL ANIMALS	7.4.5		0	0
	RARE TERRESTRIAL ANIMALS	"		0	0
	WATER BIRDS	"		-1	-1
	COMMERCIAL FISH AND SHELLFISH	"		-1	-1
	SPORT FISH AND SHELLFISH	"		-1	-1
	OTHER FISH AND SHELLFISH	"		-1	-1
	MARINE MAMMALS	"		-1	-1
CULTURAL	AESTHETICS	7.2.6			
	VISUAL - AIR QUALITY	7.4.6		-1	-1
	VISUAL - WATER QUALITY	"		-1	-2
	VISUAL - FLORA	"		0	-1
	VISUAL - FAUNA	"		-1	-2
	VISUAL - SHIPS AND STRUCTURES	"		-1	-1
	OPEN SPACE QUALITIES	"		0	-1
	NOISE	"		-1	-2
	OLFACTORY	"		-1	-1
	RECREATION	7.2.7			
	HUNTING	7.4.7		0	0
	FISHING	"		0	0
	BOATING	"		-1	-2
	SWIMMING	"		-1	-2
	PICNICKING, CAMPING AND HIKING	"		0	-1
	SIGHTSEEING	"		0	-1
	ARCHEOLOGICAL	7.2.8			
	ARCHEOLOGICAL SITES	7.4.8		0	0
	HISTORICAL SITES AND MONUMENTS	"		-1	-1

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-49
ENVIRONMENTAL ASSESSMENT MATRIX

LOCATION: OFFSHORE PORT HUENEME, CALIFORNIA

	ENVIRONMENTAL RESOURCE CATEGORIES	SECT. NO.	POTENTIAL DEVELOPMENTS		
			WITHOUT SUPER-TANKERS 2000	WITH SUPER-TANKERS 1980	WITH SUPER-TANKERS 2000
PHYSICAL AND CHEMICAL	AIR QUALITY	7.2.2			
	PRIMARY POLLUTANTS	7.5.2		-1	-1
	SECONDARY POLLUTANTS	"		0	0
	ODOR CAUSING POLLUTANTS	"		-1	-1
	VISIBILITY	"		-1	-1
	MICROCLIMATE	"		-1	-1
	WATER QUALITY	7.2.3			
	DISSOLVED AND SUSPENDED SOLIDS	7.5.3		-1	-2
	FLOATING OIL AND GREASE	"		-1	-2
	TOXICITY	7.5.5		-1	-2
BIOLOGICAL	FLORA	7.2.4			
	TERRESTRIAL PLANTS	7.5.4		-1	-1
	RARE TERRESTRIAL PLANTS	"		0	0
	AQUATIC PLANTS	"		0	0
	RARE AQUATIC PLANTS	"		0	0
	FAUNA	7.2.5			
	TERRESTRIAL ANIMALS	7.5.5		-1	-1
	RARE TERRESTRIAL ANIMALS	"		0	0
	WATER BIRDS	"		-1	-1
	COMMERCIAL FISH AND SHELLFISH	"		-1	-1
	SPORT FISH AND SHELLFISH	"		-1	-1
	OTHER FISH AND SHELLFISH	"		-1	-1
	MARINE MAMMALS	"		-1	-1
CULTURAL	AESTHETICS	7.2.6			
	VISUAL - AIR QUALITY	7.5.6		-1	-1
	VISUAL - WATER QUALITY	"		-1	-2
	VISUAL - FLORA	"		0	-1
	VISUAL - FAUNA	"		-1	-2
	VISUAL - SHIPS AND STRUCTURES	"		-1	-1
	OPEN SPACE QUALITIES	"		0	-1
	NOISE	"		-1	-2
	OLFACTORY	"		-1	-1
	RECREATION	7.2.7			
	HUNTING	7.5.7		0	0
	FISHING	"		0	0
	BOATING	"		-1	-2
	SWIMMING	"		-1	-2
	PICNICKING, CAMPING AND HIKING	"		0	-1
	SIGHTSEEING	"		0	-1
	ARCHEOLOGICAL	7.2.8			
	ARCHEOLOGICAL SITES	7.5.8		0	0
	HISTORICAL SITES AND MONUMENTS	"		0	0

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

TABLE III-50
ENVIRONMENTAL ASSESSMENT MATRIX

LOCATION: OFFSHORE ENCINA, CALIFORNIA

	ENVIRONMENTAL RESOURCE CATEGORIES	SECT NO.	POTENTIAL DEVELOPMENTS		
			WITHOUT SUPER-TANKERS 2000	WITH SUPER-TANKERS 1980-	WITH SUPER-TANKERS 2000
PHYSICAL AND CHEMICAL	AIR QUALITY	7.2.2			
	PRIMARY POLLUTANTS	7.6.2		-1	-1
	SECONDARY POLLUTANTS	"		0	0
	ODOR CAUSING POLLUTANTS	"		-1	-1
	VISIBILITY	"		-1	-1
	MICROCLIMATE	"		-1	-1
	WATER QUALITY	7.2.3			
	DISSOLVED AND SUSPENDED SOLIDS	7.6.3		-1	-2
	FLOATING OIL AND GREASE	"		0	0
	TOXICITY	7.6.5		-1	-2
BIOLOGICAL	FLORA	7.2.4			
	TERRESTRIAL PLANTS	7.6.4		-1	-1
	RARE TERRESTRIAL PLANTS	"		0	0
	AQUATIC PLANTS	"		-1	-1
	RARE AQUATIC PLANTS	"		0	0
	FAUNA	7.2.5			
	TERRESTRIAL ANIMALS	7.6.5		-1	-1
	RARE TERRESTRIAL ANIMALS	"		0	0
	WATER BIRDS	"		-1	-1
	COMMERCIAL FISH AND SHELLFISH	"		-1	-1
	SPORT FISH AND SHELLFISH	"		-1	-1
	OTHER FISH AND SHELLFISH	"		-1	-1
	MARINE MAMMALS	"		-1	-1
CULTURAL	AESTHETICS	7.2.6			
	VISUAL - AIR QUALITY	7.6.6		-1	-1
	VISUAL - WATER QUALITY	"		-1	-2
	VISUAL - FLORA	"		0	-1
	VISUAL - FAUNA	"		-1	-2
	VISUAL - SHIPS AND STRUCTURES	"		-1	-1
	OPEN SPACE QUALITIES	"		0	-2
	NOISE	"		-1	-1
	OLFACTORY	"			
	RECREATION	7.2.7			
	HUNTING	7.6.7		0	0
	FISHING	"		0	0
	BOATING	"		-1	-2
	SWIMMING	"		-1	-2
	PICNICKING, CAMPING AND HIKING	"		0	-1
	SIGHTSEEING	"		0	-1
	ARCHEOLOGICAL	7.2.8			
	ARCHEOLOGICAL SITES	7.6.8		0	0
	HISTORICAL SITES AND MONUMENTS	"		0	0

Source: "Environmental Assessment West Coast Deepwater Port Study", June 1973, Battelle Pacific Northwest Laboratories

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IV. Mitigating Measures Included in the Proposed Action

The following concerns the mitigating measures which will influence possible adverse impacts that could result from this proposed sale. These measures are presented as they relate to oil spills, offshore structures and pipelines as well as other impact-producing activities associated with this proposal.

A. Regulation

All OCS oil and gas operations will be covered by applicable regulations of county, state, and federal agencies including, but not limited to, the U.S. Geological Survey; the U.S. Environmental Protection Agency; the U.S. Army Corps of Engineers; the U.S. Coast Guard; the California State Lands Commission, Division of Oil and Gas; the Regional Water Quality Control Board, and appropriate state, regional and county air pollution control agencies. Following is a discussion of some of the mitigating measures that are applied by several government agencies to OCS operations.

1. Department of Interior

a. Bureau of Land Management

Regulations governing the granting of rights-of-way for pipelines on the OCS are administered by the Bureau of Land Management. These regulations are contained in Title 43, subpart 2883 of the Code of Federal Regulations. Under these regulations pipeline rights-of-way are limited to 200 feet in width, and further, may only occupy an area reasonably necessary for pumping stations or other accessory structures.

b. U. S. Geological Survey

Regulations governing the safe conduct of mineral operations and development on the OCS are administered by the U. S. Geological Survey (USGS). These regulations are contained in Title 30, Part 250 of the Code of Federal Regulations and are further supplemented by the Pacific OCS Order Nos. 1 through 12, which can be found in the Appendix.

The present Pacific Area OCS Orders, dated June 1, 1971[1], evolved from the earliest issued orders dated March 31, 1956. After the Platform A spill of January 28, 1969, the Geological Survey OCS Regulations were revised effective August 22, 1969, and latest revision of the Pacific Area OCS Orders became effective. The net effect of the changes that have been made in these latest revisions has been to define more clearly: 1) the responsibility of lessees to conduct safe operations; and 2) the authority of the USGS supervisor to regulate operations, to exercise tight control over drilling, production, and waste disposal, and to require equipment fully adequate for the safe conduct of operations. Additional OCS Orders will be prepared and issued and the existing orders revised as the need occurs. Several existing OCS Orders are presently undergoing revision and new orders are being prepared by the Geological Survey and should be completed by early 1975. In the case of violations, the OCS Lands Act includes punitive provisions for the enforcement of these OCS regulations and orders; however, the Pacific Area has been able, in the past, to obtain voluntary and cooperative compliance.

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[1] OCS Order Number 11 is dated May 1, 1975.
" " " 12 is dated December 1, 1974.

i. Inspection Programs and Approval Requirements

To enforce the Geological Survey Regulations and OCS Orders, a comprehensive inspection system has been developed. OCS operators must receive approval before commencing any work. Operators are required to submit a notice and detailed description of all work they desire to perform. All applications to drill are submitted to the USGS District Engineer, and are thoroughly reviewed and analyzed prior to approval or recommendation for approval to the USGS Supervisor. Simple procedures such as removing, servicing, or replacing a sub-surface valve, modifying a header, flowline, or other piping, also require approval. Each procedure or application is reviewed by a USGS petroleum engineer. If necessary, the program is either discussed with the operator or additional information is requested and reviewed prior to approval. The objective in this requirement for advance approval is to insure that no operation is conducted without thorough planning for safety, conservation, and protection of the environment, and to determine that all operations meet the requirements established by the revised regulations and OCS Orders.

- On-Site Inspections

All operations, regardless of the activity will receive regular on-site inspection for compliance with regulations and OCS Orders. For example, operations in the Dos Cuadras field (Platform Hillhouse, Lease OCS-P 0240, and Platforms A and B, Lease OCS-P 0241) are inspected daily. The inspector is on the facility for an 8-hour period, randomly observing various operations, testing equipment, and checking for pollution. The production and drilling decks are checked at least three times during this inspection period. Conversation with operating and contract personnel has proven to be a worthwhile means of being alerted to potential hazards and the need to replace or modify existing equipment. Platforms Hogan and Houchin, Lease OCS-P 0166 are presently inspected at least once a week. Critical operations are observed regardless of what time of day or night they occur.

Two onshore processing facilities handle all of the Federal OCS lease fluid and gas production. The production from Lease OCS-P 0166 is processed at the Phillips La Conchita plant and production from Leases OCS-P 0240 and OCS-P 0241 is processed at the Mobil Sea Cliff plant; both plants are near Rincon Point. These two plants are inspected weekly. Also Lease Automatic Custody Transfer (LACT) meter provings are regularly monitored at these two onshore facilities.

If a floating drilling vessel or drilling unit has not been in service for some time or if a drilling unit is new to the area, a detailed inspection will be performed to insure conformance with regulations and OCS Orders, before commencement of drilling operations. These predrilling inspections are comprehensive and often require several days to complete. After a well has been spudded and normal drilling is in progress, drilling inspections will be performed at least weekly. It is not uncommon to make daily drilling inspections at certain wells. Again, all critical phases of drilling operations are observed whatever time during the day or night they may occur. Critical phases include, but are not limited to, casing-cementing operations, casing and blowout equipment pressure tests, line-lap pressure tests, wireline work, drill-stem formation tests, and any other tests or operations not considered to be routine.

If a well is either abandoned or suspended, a Geological Survey inspector will witness the setting of all required cement plugs, the cutting of the several casing strings below the sea floor, and the removal of all subsea equipment.

Southern California OCS Inspection Program

GS has indicated that the following policy will be effected to ensure the quickest possible response should a blowout occur: Two qualified drilling rigs, both capable of drilling to projected depths requested in the lessees application to drill, shall be available in the Southern California lease area before a permit can be issued for drilling. Both rigs would be available for drilling separate locations, but either could abandon a location on a few days notice to drill a relief well for the other, if required. It would not be a requirement for a standby drilling rig, but a need for more than one rig actively drilling in the lease sale area.

The drilling phase of offshore exploration is usually initiated with use of floating mobile drilling rigs of the ship-shape, jack-up, or semi-submersible types. The inspection by USGS personnel of the drilling and safety equipment is made at dockside prior to moving to the offshore location or after the mobile rig is positioned on the drilling location. Blowout prevention and other equipment related to the drilling operation, i.e., drill pipe safety valves on the rig floor, gas detectors, drilling-rate monitors, pressure gauges, etc., are checked for installation and availability. Fire protection equipment, i.e., foam generating equipment, sprinkler systems, hand and wheeled dry chemical fire extinguishers, etc., and life raft, life preserver equipment is checked for location and service-ability. These rigs are usually inspected at least once during the drilling of a well, and the well-control and safety equipment is inspected for proper function. Equally important inspection is made of heat, audio alarm-triggering devices, sumps, spill pans, drains, and sewage disposal systems required to avoid loss of raw sewage into ocean waters.

After the drilling/production platform is installed, as justified by exploratory drilling, facilities for further development and production of the lease are installed. These facilities will have the wellhead equipment and can include a mix of equipment and piping for gas lift and hydraulic pumping, heating the oil, oil and gas separation and production, water knock-out, chemical injection, removal of sand produced with the oil, oil storage and metering, oil and gas transfer and sales, gas dehydration and compression, and emergency flaring and venting of gas. Closely associated with these facilities are mechanical, pneumatic, electrical safety and anti-pollution control devices installed as required by Federal Regulations and OCS Orders.

Well workover and well abandonment phases of OCS operations, as with drilling, receive both scheduled and unscheduled inspections depending on the progress of a particular operation. Drill stem testing, cement plugs set prior to redrilling a well, cement plugs set to temporarily or permanently abandon a well, and all casing cementing operations must be approved by a USGS representative.

OCS pipelines are installed in accordance with OCS Order No. 9, which provides for submittal of such information as purpose of each line, proposed route, water depths, capacity, operating pressures, size and grade pipe, burial depth if buried, corrosion protection, protective coating, connecting and metering facilities, and pressure control facilities. The methods of welding and laying the line are monitored, as is the installation of connecting facilities. A hydrostatic test to 1.25 times the designed working pressure of the line is made upon completion of installation.

Inspection Schedule and Enforcement

The inspection program is maintained with the intent that required regulations will be followed as closely as possible to avoid potential hazards to personnel, provide protection for the environment, and preserve the multiple use concept of the OCS lands. A detailed inspection form/check list, is utilized to insure that all systems and devices installed are adequate to attain maximum safe operations. Deficiencies in equipment or obvious unsafe operating procedures are noted and appropriate warning is given to the operating supervisor that corrective action will be taken to avoid partial or complete shut-down of operations. Warnings for incidents of non-compliance are issued and the date of correction of defects is recorded.

Offshore production facilities in the Southern California area are inspected daily (seven days a week) by USGS inspectors. Seven petroleum technicians are presently employed for inspection duties and engineers from the district office make frequent inspections of all offshore operations. Additional unscheduled inspections are made with no prior notice given to lessees.

Visual inspections of the water surface over OCS pipelines are currently made weekly by the operator for evidence of failures and leaks. These inspections are made by contract surface vessels and the results of all visual observations made during the inspection are recorded in the Boat Log on the vessel and in the Daily Diary maintained on the platforms. Actually these inspections are more frequent since USGS and operator personnel visit the production facilities daily and follow a route approximating the pipeline route. Weekly pollution inspection flights over the Southern California offshore operating area are made by USGS district personnel and includes the routes of the pipelines.

Annual external inspection of the marine pipelines, including risers to the platforms, is recorded on closed circuit television tapes made from a two-man submarine and by divers. Side scan sonar equipment is also utilized for making these external inspections. Alternate year internal inspection is made and recorded using a sensor that determines pipeline wall thickness.

Shut-down equipment, pressure sensors that continually record receiving and discharge pressures, and all other metering and safety devices are tested and witnessed by USGS personnel at least every six months. Operator personnel test many of these devices on a weekly or monthly basis and the results of the tests are reported to the USGS district office.

An approved contingency plan is required from each operator that will include spill control, containment and cleanup, and measures to be taken if there is any likelihood that hydrogen sulfide gas might be encountered during the drilling operation. When spills or hazardous conditions occur, the appropriate portion of the contingency plan would be followed.

Depending on the amount of increased offshore activity in the Southern California area, it is anticipated that the offshore inspection program will be expanded accordingly with additional personnel. Plans have already been formulated for increased helicopter surveillance of the offshore area as operations move further from the coastline. It is expected that inspection procedures will be modified where production systems are mounted on the ocean floor, and underwater television equipment now available will be utilized as well as divers and submersibles.

- Semi-Annual Inspections

In addition to the daily and weekly inspections, and the observation of all critical operations, each onshore and offshore facility is and will be subjected to a 6-month inspection. During this comprehensive test, an inspection team tests each safety device and piece of equipment as required by the OCS Orders. If the device or equipment malfunctions, it must be repaired or replaced. During a typical inspection, approximately 650 items are tested at a facility. All malfunctioning equipment and incidents of noncompliance must be immediately corrected by the operator. Normally these detailed inspections require two weeks for the inspection team to inspect one onshore or offshore facility.

Other Inspections

In addition to inspecting and witnessing operations, beach walks are frequently made to check for oil pollution. Fixed-wing aircraft and helicopter flights are made (normally biweekly) to check for oil pollution and to chart the natural oil seepage. Boat surveys are made in the immediate areas of operation to check for oil pollution. These beach walks and aerial and boat surveillances presently cover an area from Point Conception to Port Hueneme but would be extended to other areas of concern if a sale takes place. Also inspected are the areas utilized by various oil companies and Clean Seas, Inc., for storing booms, skimmers, pumps, barges, and other oil-spill containment and cleanup equipment.

Inspection Procedures for Subsea Systems

Inspection procedures for Geological Survey (GS) personnel from the Gulf of Mexico (GOM) office for encapsulated production trees, subsea manifolds, and subsea production facilities were conducted as follows. It is anticipated that the inspection program during drilling and installation phases would parallel the inspection procedures for subsea systems as outlined below.

I. SPS

   A. GS personnel from GOM and California observed assembly and pit (on land) testing of the unit in California. Testing procedures of safety devices pursuant to OCS Orders were also witnessed.

   B. GS personnel observed re-assembly of unit and testing of systems on three occassions in Louisiana.

   C. GS personnel observed launching of unit offshore Louisiana.

   D. GS personnel make weekly inspection of location where unit is undergoing tests.

II. SEAL

   A. GS personnel (GOM) inspected unit in California and witnessed land testing procedures of safety devices pursuant to OCS Orders.

   B. GS personnel witnessed launching of unit offshore Louisiana.

   C. GS personnel have made on-site inspections including trips in diving bell to the encapsulated production system.

   D. Normally scheduled inspections are made at platform where remote controls that operate the system are located.

III. LOCKHEED

   A. GS personnel observed assembly of unit in Houston, Texas.

B. GS personnel observed testing procedures of safety devices pursuant to OCS Orders in New Orleans.

C. GS personnel observed launching of unit offshore Louisiana.

D. GS personnel have participated in six on-site inspections via diving bell to wellhead capsule.

E. Normally scheduled inspections are conducted at platform where remote controls that operate the system are located.

F. GS personnel have witnessed the Subsea Manifold Center (SMC) which is Phase II of Shell Oil Company's Subsea Production System and scheduled to be installed in August of 1975.

Inspection procedures during production, workover, and abandonment phases would be pursuant to present OCS Orders, subsea inspection procedures utilized in Gulf of Mexico, and, eventually, a new OCS Order for subsea systems.

The many Federal agencies involved in the review process of subsea systems include: EPA, Coast Guard, Corps of Engineers, U.S. Fish and Wildlife, and Bureau of Land Management. Except for confidential parts, plans for exploration and development are available for review.

ii. Operator Reports

A comprehensive reporting system covering all oil spills and any unusual conditions (for example: reporting and investigation of a persistent oil slick from an unknown source such as a sunken ship or natural oil seep) is required by the OCS Orders and is a key factor in monitoring operations. Operators are also required to maintain records for inspection by Geological Survey of required periodic tests of safety equipment. Compliance with reporting requirements can be assured only by periodic on-the-site inspection and aerial monitoring.

2. Department of Transportation

a. U. S. Coast Guard

The OCS Lands Act delegates to the Coast Guard the authority to promulgate and enforce regulations covering warning devices, safety equipment, and other matters related to the promotion of safety of life and property on fixed OCS platforms and drilling vessels. The implementing regulations for this delegation are contained in Title 33 of the Code of Federal Regulations, Part 67 and Sub-chapter N, Parts 140 to 147. Other Coast Guard regulations cover safety equipment on all types of offshore facilities and boats, specific personnel licensing procedures, and minimum manning levels for ships and boats, and prohibit the discharge of pollutants from all vessels.

The Coast Guard's responsibility as to oil spill containment and cleanup is also discussed under the heading "Contingency Plans" in this section. A memorandum of understanding between the U. S. Geological Survey and the U. S. Coast Guard is also discussed under this heading.

b. Office of Pipeline Safety

The Department of Transportation is authorized under the Natural Gas Pipeline Safety Act of 1968 (49 U. S. C. secs. 1671, et seq.) to establish gas pipeline safety standards for transportation of gas and for pipeline facilities. The standards apply to the design, installation, inspection, testing, construction, extension, operation, replacement, and maintenance of pipeline facilities. Gathering, transmission or distribution by pipeline or storage in or affecting interstate or foreign commerce is included in the meaning of transportation of gas. The Secretary of Transportation is authorized to advise, assist and cooperate with other Federal departments in the planning and development of the standards and in methods for inspecting and testing to determine compliance with the standards. Regulations implementing the Department's authority are found in 49 CFR Parts 192 and 195.

3. United States Army Corps of Engineers

The OCS Land Act provides that the authority of the Secretary of the Army to prevent obstruction to navigation in the navigable waters of the United States is extended to structures located in the OCS.

The Corps of Engineers implements this delegated authority by issuing navigational permits for exploration drilling vessels and fixed and mobile platforms. In issuing these permits, the Corps only considers those hazards related to navigation and national defense.

4. Environmental Protection Agency

Produced waste water is an unavoidable consequence of producing oil and gas. Presently the Environmental Protection Agency, the State Water Resources Control Board, and the Geological Survey, as well as both State and Federal lease operators, are in the process of determining the best method, from an environmental protection standpoint, of treating and disposing of produced waste water.

The Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500; 86 Stat. 816) (hereinafter, the Act) makes the discharge of any pollutant by any person, except in compliance with certain sections of the Act, unlawful. A National Pollutant Discharge Elimination System (hereinafter, NPDES) is created by section 402 and made applicable to discharges into the territorial sea, the waters of the contiguous zone, or the oceans by section 403. Permits for discharges will be issued by the Administrator (Environmental Protection Agency) in compliance with guidelines to be promulgated by him. Prior to promulgation of such guidelines permits may be issued if the Administrator determines it to be in the public interest. While the NPDES appears to apply to fixed platforms and structures, it does not apply to (1) the addition of any pollutant to the waters of the contiguous zone or the ocean from any vessel or floating craft, or (2) water, gas, or other material which is injected into a well to facilitate production of oil or gas, or water derived in association with oil or gas production and disposed of in a well. Regulations governing the NPDES may be found at 40 CFR, Part 125, 38 Fed. Reg. 13528 (1973) and the guidelines issued pursuant to section 403 (c) of the Act may be found at 40 CFR, Part, 227, 38 Fed. Reg. 12872 (1973). Subsurface injection into OCS platform wells is in accordance with Environmental Protection Agency suggested guidelines and is subject to Geological Survey approval and regulation. In addition, the presently existing standards for oil and gas operation related discharges, into OCS waters are detailed in OCS Orders 7 and 8 (see Appendix 5).

5. California Environmental Quality Act

The California Environmental Quality Act (CEQA) of 1970 lists guidelines and procedures for the preparation of environmental impact reports for activities affecting the environment in areas of State jurisdication. Although the proposed Federal action of leasing 297 tracts in the Southern California Borderland does not fall under State jurisdiction, the preparation of the environmental impact statement for this proposal under the guidelines of the National Environmental Policy Act (NEPA) of 1969 conforms with the intent and spirit of CEQA. It is possible that some of the activities that could result from this proposed action, such as onshore facility construction, would be covered by CEQA and could require the preparation of a State environmental impact report.

6. Preliminary Coastal Plan

The Preliminary Coastal Plan of the California Coastal Zone Conservation Commission places restrictions on development in the Coastal Zone. Any OCS related onshore development would be coordinated with the Final Coastal Plan and its administrative agency. BLM will work closely with the Coastal Commission or its successor agency to mitigate any OCS related onshore development.

7. Buffer Zones

In a letter from the California State Lands Commission dated April 17, 1974, to BLM, Pacific OCS Office, a request was made to consider establishing buffer zones adjacent to State Offshore sanctuaries. The purpose of these buffer zones is to protect submerged State lands from drainage of oil and gas reserves that might occur as a result of development of adjacent Federal leases. At a hearing conducted by the California Assembly Select Committee on Coastal Zone Resources in Santa Monica on April 9, 1974, testimony was presented by personnel of the State Lands Commission that a buffer zone of 1/4 mile was adequate. Subsequent to this a buffer zone of 3/4 mile was established by the Manager, Pacific OCS Office to ensure the protection of sensitive State Santuaries. (See Graphic I)

B. Enforcement

The enforcement policy is intended to reduce the frequency of noncompliance with lease requirements that may lead to loss of life, loss of property and resources, or damage to the environment. In 1971 new and more detailed standardized inspection procedures were established for OCS operations. The requirements in the OCS Orders and Regulations were expressed as a check list of specific items relating to safety equipment and procedures. The items reflect the existence of potentially hazardous conditions if the specified equipment is missing or not operable, or specified procedures are not followed. This compilation of items is titled "List of Potential Items of Noncompliance and Enforcement Action," and referred to as the (PINC) list.

During an inspection of drilling and production operations, depending on the hazard presented toward safety or pollution, either a written warning will be given that allows the operator 7 days to correct the incident of noncompliance (INC), or a shut-in order will be issued. The shut-in order may be applied only to the equipment affected by the incident of noncompliance (INC), such as a particular piece of production equipment or a producing zone, or to the entire drilling rig, production platform, or onshore facility. To date, in the California OCS area, incidents of noncompliance have been minor in nature, requiring only a warning that corrections be made within 7 days.

Additional penalties for noncompliance are specified in Sec. 5(a)(2) of the Outer Continental Shelf Lands Act (43 U.S.C. Sec. 1334(a)(2). "Any person who knowingly and willfully violates any rule or regulation prescribed by the Secretary for the prevention of waste, the conservation of natural resources, or the protection of correlative rights shall be deemed guilty of a misdemeanor and punishable by a fine of not more than $2,000 or by imprisonment, and each day of the violation shall be deemed a separate offense." Also Sec. 5(b)(1) and (2) provides for cancellation by notice of nonproducing and producing leases subject to judicial review or appropriate judicial proceedings.

C. Oil Spill Contingency Plans

Oil spills occur as a result of natural disasters, equipment failure, or human error. For this reason OCS Order No. 7 sets forth a reporting procedure for notifying appropriate persons and agencies and requires that immediate corrective action be taken. Additionally, it requires that all OCS operators have an approved spill contingency plan which includes spill cleanup and containment equipment. This pollution control equipment may be maintained on the particular facility or, at the discretion of the Area Supervisor, may be land based.

1. Region Nine Multi-Agency Oil and Hazardous Materials Pollution Contingency Plan

The Region Nine Contingency Plan, prepared by the Coast Guard, is effective for coastal waters within the Standard Federal Administrative Region Nine, which is the area of California, Hawaii, Guam, American Samoa and the U. S. Trust Territory of the Pacific Islands. The Region Nine Contingency Plan was issued by the Commander, Twelfth Coast Guard District, December 1970 and revised December 1971.

This plan provides for a pattern of coordinated and integrated response by departments and agencies of the Federal Government to protect the environment from damaging effects of spills. It also promotes the coordination and direction of Federal, State, and local response systems and encourages the development of local government and private capabilities to handle spills. The Region Nine Contingency Plan provides for and describes the functions of a Regional Response Team (RRT) and an On-Scene Coordinator (OSC).

The roles of the RRT and the OCS as related to spills resulting from oil and gas operations will be further discussed later in this section.

Region Nine is divided into sub-regions and zones for pollution planning purposes. Therefore the Region Nine Contingency Plan contains five appendices, one for each sub-region. The California Sub-region is divided into two zones, Southern California (includes the Santa Barbara Channel) and Northern California. The Appendix for California (Appendix I) is divided into two sections. The five appendices, one for each

State and Territory are listed below:

Appendix I - California (Sub-region one)

Zone One Section - Southern California

Zone Two Section - Northern California

Appendix II - Hawaii (Sub-region Two)

Appendix III - American Samoa (Sub-region Three)

Appendix IV - Territory of Guam (Sub-region Four)

Appendix V - The Trust Territories of the Pacific Islands (Sub-region Five)

There are three Coast Guard districts within Region Nine: the Eleventh headquarters in Long Beach which is responsible for Appendix I, zone one; the Twelfth headquarters in San Francisco which is responsible for Appendix I, zone two; and the Fourteenth Coast Guard District, Honolulu, which is responsible for Appendixes II, III, IV, and V.

For Sub-region One, zone one (Southern California) the pre-designated On-Scene Coordinator (OSC) is the Commander of the Eleventh Coast Guard District. In order to more effectively coordinate cleanup activities and to expeditiously establish and maintain liaison with local communities, the Commander, Eleventh Coast Guard District has delegated the responsibility of OCS as follows:

- Captain of the Port, San Diego - for waters adjacent to San Diego County.
- Captain of the Port, Los Angeles/Long Beach - for waters adjacent to Los Angeles and Orange Counties.
- Commander, Coast Guard Group Santa Barbara - for waters adjacent to Santa Barbara and Ventura Counties (the Santa

Barbara Channel area).

The Eleventh Coast Guard District, with the help of State and Federal agencies such as the California Department of Fish and Game and the U. S. Fish and Wildlife Service, has compiled hundreds of pages of data for the Southern California area to aid the OSC in advising and making decisions during an oil spill emergency. These data consist of such information as: coastline characteristics (shore and shoreline, accesses, outfall and inlets, beach usage, property owners controlling beach access, etc.) critical water uses, marine biological factors, meteorological and climatological factors, oceanographic factors (i.e. current patterns, water characteristics). A portion of these data are physically incorporated into the Regional Contingency Plan; the remainder are on file and readily available. These data would be used to predict the movement of an oil spill and to determine the order of priority for protection and cleanup of certain areas.

a. Regional Response Team and On-Scene Coordinator Functions

In the event of a spill originating from an oil and gas operation the lessee or responsible party must take the initiative in combating the resulting oil spill. The Coast Guard OSC is to determine pertinent facts about the particular spill and give advice and assistance. If it is determined by the OSC and RRT that the lessee is not capable of, or is not willing to, adequately combat the spill, the OSC will take over control of the operation and become the On-Scene Commander rather than On-Scene Coordinator.

The Commanders of the Coast Guard Districts are responsible for chairing the regular RRT meetings and activating the RRT in the event of a spill situation meriting such action. The RRT consists of regional representatives of the primary and selected advising agencies, as appropriate. Appropriate private organizations are frequently invited to attend the regular RRT meetings. The Coast Guard and Navy are government members of the RRT with capability to supply oil-spill-combating equipment, and will do so for spills originating from oil and gas operations if the situation justifies such action.

The RRT advises the OCS during time of emergency and performs review and advisory functions relative to the regional plan. Additionally the RRT helps to determine if and when the On-Scene Coordinator should take over a spill-combating operation and become the On-Scene Commander. The OCS is to fully inform and coordinate closely with the RRT to ensure the maximum effectiveness of the Federal effort to protect the natural resources and the environment from pollution damage.

b. U. S. Geological Survey and U. S. Coast Guard Responsibilities

A memorandum of understanding between the Departments of the Interior and Transportation outlines the respective responsibilities of the Geological Survey and the Coast Guard as to spills originating from oil and gas operations. It spells out that the Geological Survey is responsible for the coordination and direction of measures to abate the source of pollution. The Coast Guard is responsible for containment and removal operations.

2. California Oil Spill Disaster Contingency Plan

The State of California has developed the California Oil Spill Contingency Plan. This State Plan is similar to the National and Regional Contingency Plans but has been written from the standpoint of the State of California and the State agencies. It was framed in such a way as to serve as an extension of the Federal Plans. It provides also for the State's response organizations to act, whether or not Federal forces are activated. The State Contingency Plan provides for a State Operating Authority (SOA), and the SOA is charged with the responsibility and delegated authority for planning and directing the coordinated overall operations for all State and local government agencies engaged in helping to combat a spill. The SOA coordinates these operations with Federal agencies and private organizations and regularly participates in the Regional Response Team meetings. The SOA, under the leadership of the Federal On-Scene Coordinator, directs the State and local government agency oil spill response operations. The State Oil Spill Contingency was revised March 1974.

3. Local Contingency Plans

Local Federal, Co-operatives, Private and other groups also have detailed contingency plans. These include groups such as the Navy Construction Battallion Base at Port Hueneme, Long Beach Naval Shipyard, San Diego Naval Shipyard, Clean Seas Inc., Clean Coastal Waters etc. Local contingency plans are quite detailed listing equipment, plane numbers, etc. and therefore, are subject to frequent updating.

4. Oil Spill Cleanup Funding

When an oil spill occurs and immediate funds are not available to combat it, or the party responsible for the spill cannot be immediately identified, there is a 35 million dollar Oil Pollution Revolving Fund administered by the U. S. Coast Guard that can immediately be brought into use.

5. Status of Oil Spill Containment and Cleanup Technology

Government, industry, and universities have pursued multimillion dollar research programs since the 1969 Platform A, Santa Barbara Channel oil spill to improve procedures and equipment to effectively deal with offshore oil spills.

To date, no system or equipment has been developed which is 100 percent effective in controlling and removing pollution under all weather and sea conditions. However, much research and development has been conducted by the government and industry since the Platform A blowout and is being continued at an accelerated level. The floating boom is the primary containment device to date. Booms contain an oil slick by encircling, sweeping or directing it to a collection point or by a combination of these efforts. The boom's floatation system may be a part of or separate from the containment section. Typically a fence or skirt extending above and below the water surface forms the containment section.

The effectiveness of a boom is limited by waves, winds, and currents.

To date the best boom performance that has been reported (Exxon) is containment in 6- to 8-foot seas with 20-mile winds and 1.25-mile currents. The U. S. Coast Guard has also developed a mechanical containment and recovery system for the open ocean with a capability of 50 barrels per minute. Presently there is no known method of containment or cleanup which is effective in turbulent seas where wave heights exceed eight feet. See Section II.C. for estimates of wave heights and frequency of occurrence in the Borderland area.

Mechanical cleanup devices are generally limited to calm waters. They operate at low recovery rates -- generally 1 to 5 barrels per minute -- and thus are of limited effectiveness for large spills.

Surface tension modifiers and collecting agents have also been used with limited success. These agents present or restrict the rapid spread of oil on the ocean's surface. Use of these agents must be approved by the U. S. Coast Guard On-Scene Commander on a case by case basis.

Straw, manufactured fibers, and absorbent clays are spread on a slick, mixed with the oil, and collected. Straw is considered the most cost-effective sorbent because it holds five times its weight in oil and costs $25 to $50 per ton. There are serious logistical problems in spreading and collecting the sorbents as well as disposing of the oil-contaminated materials.

The use of dispersants as well as burning and sinking agents in U. S. coastal waters is strictly limited by the National Contingency

Plan because of their potentially toxic effects on marine organisms. They are prohibited in California waters.

6. Organizations Dealing With Spill Containment And Removal

During the last four years, several specialized groups have been formed along the Pacific Coast, for pollution control; these function in the manner of fire stations. These organizations are of four basic types: (1) Federal agencies, (2) nonprofit corporations which have their own equipment, (3) cooperative organizations which have contracted for the use of local, privately owned equipment, and (4) private companies available on a contract basis.

It should be emphasized that the above groups have been developed around the growing need for response to harbor spills and the majority of their equipment is harbor oriented and will not be effective in the offshore areas, although the technology and techniques exist.

To discuss these organizations, they will be broken into the 3 geographical areas of Santa Barbara, Long Beach and San Diego. The first U. S. Coast Guard Group covers all areas. The local U. S. Coast Guard Commander or Captain of the Port is the overriding field authority and is designated as the On-Scene Commander.

a. United States Coast Guard
Pacific Team, National Strike Force
U. S. Coast Guard Base, San Francisco
Yerba Buena Island
San Francisco, California 99130

(415) 556-0729

The strike force is located in San Francisco and represents a competent, trained group of experts with training and experience in dealing with oil spills. Of the 15 people represented, four are constantly on call and can be at any site within California in less than two hours. The remaining 11 will be on site within 12 hours.

The Strike Force's equipment inventory is constantly growing. At the present time it includes:

- 7 ADAPS submersible pumps. Each pump can pump from 60 to 1,500 gallons per minut (gpm) of No. 1 to 6 fuel oils from an 85 foot depth. During one test a unit pumped 1,000 gpm of Bunker C at 50°F from a height of 37 feet.
- 7 containers of ADC High Sea Barrier boom. Each container holds 612 feet of the 48 inch boom.
- 1,000 feet of 36" Coastal Barrier Boom.
- One OS1-125 Advancing Wier Type Skimmer. This 3,500 pound unit is approximately 6' x 4' and can pump 125 gpm with a 1,000 gallon storage capability.
- A USCG "home built" weir type skimmer mounted on a 6 foot square aluminum frame.

b. Santa Barbara Area

i. The Naval Construction Battalion Base at Port Hueneme. The Port Services Officer has the Navy responsibility for Harbor Clean Up. There are four military watch sections constantly on call with each section consisting of 8 to 10 men. The sections practice frequently to increase their effectiveness. There are also a number of qualified civilians (Public Works Personnel) at the base.

The base is just starting to acquire equipment. At present in addition to a "home built" oil skimmer, they will soon be getting a JBF DIP-3001 Oil Skimmer. On hand they have 1,500 feet of Type I, Class I 36 inch boom.

ii. The local cooperative in the Santa Barbara is Clean Seas, Inc. (CSI).

CSI is comprised of 15 oil companies presently operating in the Santa Barbara Channel Area. The membership agreement allows the member companies involved to supplement their individual contingency plans by using all, or any part of, the CSI organization. CSI is also available to nonmembers and government agencies such as the Coast Guard, the Environmental Protection Agency and the Navy for combating oil spills related to nonmembers. It would also be available for use in other areas of Southern California in the event of future sales. Provisions can be made for the rapid transportation of this equipment by Coast Guard C-130 aircraft or helicopter.

The size and frequency of oil spills in the Santa Barbara area has created the environment in which CSI has a well developed capability. CSI has a large inventory of oil recovery equipment and relies on several local contractors to provide the labor force. The local contractors do not have much equipment. An example of significant equipment in the CSI inventory includes:

- CSI Skimmer System:

  One (1) CSI Skimmer System consisting of a 45-foot by 17-foot by 6-foot catamaran-type, adjustable weir skimmer barge, two 240-foot lengths of 30-inch Kepner Sea Curtain Boom, a 2,000 GPM pumping system and two (2) 100 barrel oil-water, separation tanks.

- Capability:

  This system is capable of recovering all grades of oil from light to bunker C at rates up to 2,000 GPM plus some debris and sorbent material in all conditions up to and including significant waves of 5-6 feet and 20 knot winds.

- Sea Dragon:

  One (1) Sea Dragon Skimmer system consisting of a 45-foot by 26-foot by 8-foot catamaran-type barge equipped with a liquid oil recovery system and a conveyor system for recovery of sorbent and debris, two 240-foot lengths of 30-inch Kepner Sea Curtain Boom and hydraulic system driven by a diesel power package.

  Capability:

  This sytem will be capable of recovering all grades of oil from light to bunker C at rates up to 50 GPM plus large amounts of debris and sorbent material in all conditions up to and including significant waves of 6-8 feet and 25 knot winds.

- Mark II Skimmers:

  Two (2) Mark II Skimmers, 14-foot by 27-foot weir type are available. These may be used, one on each side of a vessel or may be used singularly. Recovery system can be either the 80 barrel, skid mounted vacuum tank or compressed-air driven Wilden pumps and 100 bbl. oil-water separation tanks, all of which are available.

  Capability:

  These are very simple skimmers and may be used in a number of ways to solve the particular problem at hand. All grades of oil from light to bunker C can be recovered plus small amounts of debris. Fluid recovery rates from 50 GPM to 200 GPM are available. These skimmers are limited to 14-16 knot wind, 2-3 feet waves of 4-4.6 second period and significant waves of 3-5 feet.

- 2,000-foot Bottom Tension Boom:

  This is a heavy duty, open ocean containment boom with 4-foot by 13-foot floats and 8-foot curtain, extending 3 1/2 feet above water line and 4 1/2 feet below water line. Usually stored on land and deployed from beach, requiring 12 to 24 hours for a 1,000-foot length. May be anchored in ocean for long period of time for immediate availability.

  Capability:

  Will contain oil in 6-8 foot significant waves and winds to 25 knots at currents up to 1 1/4 knots. In calm seas, this boom has been moved through and contained oil in a "U" configuration at speeds in excess of 2 knots without underflow.

- 1,600-foot VIKOMA Seapack and Seaboom (2 units for a total of 3,200 feet):

  For very fast response to oil spills, the VIKOMA Seapack with 1,600 feet of Seaboom has just been purchased. Seapack is based on a 23-foot hull and contains 1,600 feet of Seaboom connected at one end to a diesel-driven fan and ducted propeller water pump. The VIKOMA Seapack unit can be transported by road trailer, could also be transported by aircraft.

  Capability:

  Experience in the English Channel and by the Swedish Coast Guard over the past several years indicates this boom can be on scene and deployed in less than an hour. It is effective in preventing spread of oil in significant waves up to 6 feet and winds of 20 to 25 knots. In the mode in which this boom is used, there is little or no current across boom which could cause loss of oil due to underflow. On October 26, 1973 a deployment test was conducted in the Santa Barbara Channel and witnessed by personnel representing the Geological Survey, Coast Guard, State Lands Commission, oil industry and the news media. Only 18 minutes elapsed from initial extraction of the 1,600-foot boom from the hull of the vessel until full inflation and ballast was complete.

- Tide Mar VII Barge:

  One (1) 641 ton tank barge, Tide Mar VII, for collecting oil picked up by skimmers as they work in an oil spill. May also be used to haul liquid drilling mud to drilling operations. This is a 160-foot by 39-foot by 13-foot ocean-going barge with 10 tanks, capacity of 7,840 barrels, and 6 diesel engine-driven pumps.

c. Long Beach Area

i. The Long Beach Naval Shipyard has a limited oil spill recovery capability, however there has been such little requirement for them that they contract most of the work out.

ii. The local cooperative in Long Beach was formerly known as the Petroleum Industry Coastal Emergency Cooperative (P.I.C.E.), however it has just been renamed to "Clean Coastal Waters". Clean

Coastal Waters is comprised of 13 organizations presently operating in the Long Beach area and is formed and operated in the same manner as Clean Seas, Inc. discussed in paragraph b, ii above. Significant equipment in their inventory includes

- Marco Mark II, Class 2 Skimmer
- 5,000 feet of 48" Kepner Sea Curtain boom
- 5,000 feet of 36" kepner Sea Curtain boom
- 2,000 barrel oil barge

iii. The majority of oil recovery in all Long Beach area is accomplished by two private contractors; Crosby and Overton, and Hutchinson and Sons. Both contractors have their own equipment, however none of it is really applicable to offshore work.

d. San Diego Area

i. The Naval Station in San Diego has an oil recovery division with a present manning level of 18 men. Significant recovery equipment includes a JBF-DIP-3001 skimmer and a converted Mike-6 boat with a modified Lockheed drum mounted in the front of it. They also have approximately 4,000 feet of the 36" type II boom.

The Naval Air Station in North Island and the fuel farm in Ballast Point also have oil recovery capabilities, however, they are more detailed.

ii. The Pepper Tank Co. is the major private local contactor working in the area. They do not have any equipment that would be effective in offshore use.

7. Off-shore Cleanup Equipment

Significant labor pools and expertise with experience currently exist along the Southern California shoreline. When considering a major offshore oil spill, however, the only heavy duty equipment that presently exists is that which is located at the U. S. Coast Guard's National Strike Force Headquarters in San Francisco and the 2,000 feet of boom at Clean Seas in Santa Barbara.

As to additional equipment, particularly heavy duty boom and ocean skimmers, the technology exists and the equipment can be provided. On May 7, 1975 Forrest M. Smith, representing the Western Oil and Gas Association, made the following statement at the public hearing addressing this environmental statement:

> Industry will prepare a contingency plan for each facility and will have on hand equipment to effectively respond to accidental spills in the entire SC-OCS. As a means of insuring this position, WOGA member companies have unanimously adopted a resolution stating:
>
> "That member companies of WOGA agree that the most modern technology available to contain and clean up spills in the ocean will be made available for use in all operations on leases granted at the 1975 Lease Sale offshore of Southern California, and the companies will continue to work on improvement of present technology."

8. Solid Waste

a. Exploration and Construction

Any plan submitted for approval must provide for proper disposal of solid wastes and garbage generated during construction and use of any offshore facilities.

b. Oil Spill Contingency Plans

Each oil spill contingency plan must provide for the disposal of oil-contaminated wastes generated by an oil spill and should identify disposal sites and evaluate the impact of these wastes on the site. These waste management considerations must be correlated with the local agencies responsible for solid waste management in the affected areas.

D. Mitigations Included for Specific Phases of the Proposed Action

1. Structures

The traffic separation scheme in the study area consists of the main shipping lanes which traverse northward from Long Beach, California up through the Santa Barbara Channel and southward from Long Beach through the Gulf of Catalina (as of January 1, 1975 - see Section III.G.). (See Graphic 1). This traffic scheme provides for a one-mile-wide traffic lane for each northbound or southbound ship, with a two-mile wide separation zone between the lanes. There is no record of a platform-vessel collision off the West Coast. and in the Gulf of Mexico, where platform densities are greater, there has been one such collision since 1964.

A safety fairway has been established heading south from the Oxnard - Port Hueneme area (see Graphic 1). The pertinent portion of the Federal Regulations (33 CFR Sec. 209.138(b), 1974), governing safety fairways is as follows:

> The Department of the Army will grant no permits for the erection of structures in the fairway area, since structures located therein would constitute obstructions to navigation.

If a ship strays from established safety fairways or sea lanes, oil and gas platforms can pose a hazard to commercial shipping (see Graphic 1). However, this hazard is minimized by the fact that safety fairways and sea lanes are clearly designated on navigation charts. Directional drilling from outside sea lanes is used to develop tracts lying partially in sea lanes.

If leasing takes place, development of the tracts in this proposed sale which lie partially within shipping lanes or anchorage areas will be subject to the Federal regulations governing sea lanes presented in the first paragraph above so far as placement of structures is concerned. This would help mitigate any potential impacts due to the proximity of structures to relatively high frequency sea traffic.

Commercial vessels are required to report to the Coast Guard whenever a casualty results in any of the following: (a) actual physical damage to property in excess of $1,500, (b) material damage affecting the seaworthiness or efficiency of a vessel, (c) stranding or grounding, (d) loss of life, (e) injury causing any person to remain incapacitated for a period in excess of 72 hours; except injury to harbor workers not resulting in death and not resulting from vessel casualty or vessel equipment casualty. Drilling and production platforms (artificial islands) are required to report to the Coast Guard when involved in a casualty or accident and if any of the following occur: (a) if hit by a vessel and damage to property exceeds $1,500, (b) damage to fixed structure exceeds $25,000, (c) material damage affecting usefullness of livesaving or firefighting equipment, or (d) loss of life.

The Area Oil and Gas Supervisor does consider the views of commercial fishing organizations with regard to placement of platforms. The Supervisor also from time to time requests information from the Department of Commerce, National Oceanic and Atmospheric Administration, and National Marine Fisheries Service to be used in his decision-making process of approving or disapproving platform installation.

To further mitigate the impact of offshore structures resulting from this proposed sale with regard to commercial fishing and other significant existing or future uses of the leased area, a lease stipulation giving effect to the following will be applied to all blocks in this proposed offering in the event they should lease:

> Structures for drilling or production, including pipelines, shall be kept to the minimum necessary for proper exploration, development and production and to the greatest extent consistent therewith, shall be placed so as not to interfere with other significant uses of the Outer Continental Shelf including commercial fishing. To this end, no structure for drilling or production, including pipelines, may be placed on the Outer Continental Shelf until the Supervisor has found that the structure is necessary for the proper exploration, development, and production of the leased area and that no reasonable alternative placement would cause less interference with other significant uses of the Outer Continental Shelf including commercial fishing. The lessee's exploratory and development plans, filed under 30 CFR 250.34, shall identify the anticipated placement and grouping of necessary structures, including pipelines, showing how such placement and grouping will have the minimum practicable effect on the other significant uses of the Outer Continental Shelf, including commercial fishing.

a. Platform Beautification

Platform beautification techniques have been developed. These range from camouflage of the structure to techniques that accentuate the platform but in a modified form which may be more pleasing to the viewer. Screening may be accomplished by the use of panels and configurations to change the shape or clarity of the structure's silhouette. Another method uses sea water sprayed from the upper levels of the structure. Natural light from behind the platform causes the spray to appear as a white screen on bright days to reflect the natural sky color in more typical hazy weather. Under certain light conditions the screened platform becomes less visible and tends to disappear from view.

Although the above-mentioned measures as yet have not been developed and evaluated sufficiently to propose their implementation, some measures, such as screening of work lights, use of mirrors, and platform design configuration appear to offer possibilities for limited mitigation. However, the U. S. Coast Guard has expressed concern that camouflaging techniques could increase the hazard to navigation and this would have to be a prime consideration in platform beautification studies.

b. Platform Removal

Platforms are designed for removal after their operational life. Following the depletion of all producing zones developed from a platform, wells would be plugged and abandoned. Well conductors would be cut below the mudline and removed; drilling and production equipment would be dismantled and removed; and the deck units would be removed. All piling would be cut below the mudline, and the jacket legs and buoyancy tanks would be deballasted until the jacket floated. The jacket would then be removed and the site restored in accordance with permit requirements. An example of this was the recent removal of platform Harry from state waters in the Santa Barbara Channel.

2. Pipelines

The potential impacts of each specific nearshore and coastal pipeline construction project are considered by the Department in its review of Corps of Engineers permit applications.

Data concerning the miles and sizes of pipes needed, proposed routes, amount of dredging anticipated, can only be estimated roughly until such time as the exact location of production has been delineated. The Department will conduct an environmental analysis of any application for a pipeline right-of-way that it receives. If it is determined that a pipeline right-of-way will have a major impact on the marine or coastal environment, then an environmental impact statement will be prepared.

At present the cooperative effort between the Department of the Interior, Corps of Engineers, National Marine Fisheries Service and state conservation agencies is responsible for minimizing the impact of pipeline (and other) construction in navigable waters of the United States in the following manner. The Corps of Engineers, through authority of the Rivers and Harbors Act of 1899, (33 U. S. C. 403) asserts authority over, and requires a permit for construction in all navigable waters subject to the Submerged Lands Act (43 U. S. C. § 1301) and includes all lands permanently or periodically covered by tidal waters up to the line of mean high tide.

The Environmental Protection Agency reviews and comments on dredging projects in navigable waters in accordance with a memorandum of understanding with the Corps of Engineers dated July 13, 1967.

The National Oceanic and Atmospheric Administration (through its National Marine Fisheries Service) has been vested with responsibility for participation in matters relating to marine and estuarine areas. The U. S. Fish and Wildlife Service, with assistance from appropriate State and Federal agencies, including the National Marine Fisheries Service now reviews all applications to the Corps of Engineers for permits to construct pipelines in navigable waters and assess their potential impact on fish and wildlife resources and the environment. Especially sensitive areas such as any Area of Special Biological Significance, bay or estuary occupied by rare or endangered species would be examined very critically. When appropriate, the Agency recommends to the Corps specific modification of project plans which are needed to reduce impact on these resources.

In addition to the above efforts to mitigate potential impacts associated with pipelines, the Bureau of Land Management and the Geological Survey, by virtue of a memorandum of understanding, have taken steps to clearly define their respective administrative and operational roles. The purposes and objectives are to: 1) minimize or eliminate environmental damage; 2) better serve industry and public interests; and 3) streamline the regulations and procedures for most efficient and uniform administration, operation, and industry compliance. The full text of this memorandum can be found in Appendix 19. This clarifies the administrative and operational roles of both BLM and USGS in regards to OCS pipeline management.

Each application for a pipeline right-of-way will be reviewed on a case by case basis by the Manager, Pacific OCS Office. Burial of pipelines as well as valves and taps may be required in water depths of 250 feet or deeper if in his judgment the exposed pipeline, etc. will interfere with commercial fishing or other significant uses of the OCS. Some of the extenuating circumstances which may preclude pipeline burial are:

1) possible resuspension of toxic bottom sediments;
2) interference with areas of unique biological significance;
3) presence of rocky bottoms or other topographic features of significance;
4) extreme water depths.

Further, if in the judgment of the manager, this pipeline construction would constitute a major federal action which may effect the quality of the environment, an environmental impact statement may be required prior to any action. In conjunction with the above there are some specific measures which will mitigate adverse environmental impacts. Specifically they are: 1) OCS Order Number 9 - Approval Procedure for Pipelines (not common carrier except that portion connected to or crossing a structure), 2) Code of Federal Regulations (CFR) Title 43, Subpart 2883,

3) Code of Federal Regulations, Title 30, Parts 250.18, 250.19.

3. Pipeline Corridors

Pipeline corridors are designated rights-of-way for one or more pipelines and would provide means to lower the chances for pipeline structural failures and/or interferences due to dragging ship anchors, geological hazards, and commercial trawlers and nets. A system study is planned to be conducted on the pipeline corridors considering the proximity of the oil fields, the current state-of-the art of pipelaying technology, and environmental impacts. Any corridor considerations will be closely coordinated with appropriate state agencies. An environmental analysis report (EAR) must be prepared prior to action on any pipeline corridor.

E. Other Mitigating Measures

1. Mitigating Factors Involving the Relationship of Potential Activities to Missile Overflights

All potential federal oil and gas operations have been coordinated with the Department of Defense prior to track selection to rule out high risk areas.

2. Well-Control Training Programs for Operating Personnel

Uncontrolled well flow would be further mitigated by personnel training and operating practices which are presently in effect. Daily functional tests are conducted on the blowout preventers and weekly pressure tests are made. Blowout preventer drills, which familiarize crews with proper procedures and make sure they respond properly, are conducted daily until the crews are proficient. After that, weekly drills are conducted. If a slow response is found, more frequent drills are conducted until the response is satisfactory.

In addition, key supervisory personnel of both operator and the drilling contractor receive extensive well-control training at special facilities such as the Saticoy Well Control Training Facility located in the Saticoy Field near Ventura, California. This mile-deep practice well is equipped with storage tanks, a pump, control manifold, and a full array of pressure gauges and controls, modeling the diverse equipment that is used on actual wells to prevent a blowout. These training facilities are utilized to provide actual practice in controlling a simulated well kick. Training sessions include classroom instruction in the detection and handling of abnormal well conditions.

3. Non-Use of Polychlorinated Biphenyl (PCB) Liquids

Polychlorinated biphenyl liquids in the past have been used as a heat exchange fluid to assist in the separation of oil, water and gas. Studies have shown that this material is toxic and could constitute a hazard. The use of PCB's was banned in the Gulf of Mexico by a USGS notice to lessees and Operators (number 73-3, dated 2/16/73) effective June 1, 1973. PCB's are not used on any of the existing federal platforms on the OCS nor would their use be permitted by the USGS Area Supervisor in the future.

4. Other Requirements and Practices

a. Special Stipulations

Leases for oil and gas exploration and development are subject to all OCS operating regulations and orders. Additionally, where appropriate, the lease will include special stipulations which are considered necessary for the protection of a particular resource or activity. These stipulations are designed to meet the needs of mineral resources, wildlife or waterfowl refuges, fishing areas, certain recreation areas, protection of archeological or historical values, etc., which might be quite sensitive to development of the lease.

i. Section 2(b) of Executive Order 11593 requires that, until inventories and evaluations can be completed, caution should be exercised over federally owned property to avoid damage or alteration of cultural resources potentially suitable for inclusion on the National Register of Historic Places. It is proposed that the following stipulations be applied to any lease resulting from this proposed sale for the protection of historical, archaeological, architectural, biological, or mineral values.

a) If the Supervisor, having reason to believe that a site, structure, or object of historical or archeological significance, hereinafter referred to as "cultural resource" may exist in the lease area, shall, within one year from the effective date of this lease, give the lessee written notice that the lessor is invoking the provisions upon receipt of such notice comply with the following requirements:

Prior to any drilling activity or the construction or placement of any structure for exploration or development on the lease, including, but not limited to, well drilling and pipeline and platform placement, hereinafter referred to as "operation", the lessee shall conduct geophysical surveys to determine the potential existence of any cultural resource that may be affected by such operation. If such geophysical surveys show anomalies that suggest the potential existence of a cultural resource that may be adversely affected by any lease operation, the lessee shall:

(1) relocate the site of such operation so as not to adversely affect the anomaly identified; or (2) establish, to the satisfaction of the Supervisor, on the basis of an archeologist using such survey equipment and techniques as deemed necessary by said archeologist, either that such operation will not adversely affect the anomaly identified or that the potential cultural resource suggested by the occurrence of the anomaly does not exist.

All data obtained in the course of any geophysical or archeological surveys conducted pursuant to the provisions hereof shall be submitted to the Supervisor with any application by the lessee for drilling or other activity. After consideration of such data, the Supervisor will prepare a report on his determination regarding the existence of and need for protection of any potential cultural resource, and shall forward such report to the Manager, Pacific OCS Office, Bureau of Land Management, for his review and recommendations. Upon consideration of the recommendations, if any, of the Manager, Pacific OCS Office, the Supervisor will prepare a final report, a copy of which shall be supplied to the lessee. Should the Supervisor determine in his report, contrary to the contentions of the lessee, that the existence of a cultural resource which may be adversely affected by such operation is sufficiently established to warrant protection, the lessee shall take no action that may result in an adverse effect on such cultural resource until the Supervisor has given directions as to its disposition.*

b) The lessee agrees that, if any site, structure, or object of historical or archeological significance, hereinafter referred to as "cultural resource", should be discovered during the conduct of any operations on the leased area, he shall report immediately such findings to the Supervisor, and make every reasonable effort to preserve and protect the cultural resource from damage until the Supervisor has given directions as to its disposition.

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* Adversely effected sites which may be eligible for inclusion on the National Register of Historic Places will be handled according to procedures outlined in 36CFR Part 800 (1974).

ii. The lessee shall have the pollution containment and removal equipment available as required by OCS Order No. 7 of June 1, 1971 as may be amended. Prior to drilling, the lessee shall demonstrate to the satisfaction of the Area Supervisor, U.S. Geological Survey, that said oil spill containment and removal equipment is adequate and deployable in sufficient time to prevent to the maximum extent possible using the best available technology and all reasonable care, spill damage to Areas or Special Biological Significance (ASBS), marine life refuges and/or ecological reserves which occur in closest proximity to the planned production areas(s). In the event of a significant oil spill as defined by OCS Order No. 7, or an oil spill of any size or quantity which cannot be immediately controlled, the operator shall immediately notify the Supervisor and deploy the appropriate equipment to the site of the oil spill, unless, because of weather and attendant safety of personnel the Supervisor shall modify this requirement.

iii. Should any new areas of special biological significance be discovered within two (2) years of the lease sale or as a result of BLM Baseline Studies, whichever terminates first, the lease block(s) or portion(s) thereof containing these areas and appropriate buffer zones shall be explored and developed when the lessee has demonstrated to the satisfaction of the Area Supervisor U.S.G.S. that adequate technology and sufficient environmental safeguards exist and will be used to prevent to the maximum extent possible, using the best available technology and all reasonable care, detrimental impact upon such areas.

If within the above specified time limit, the Supervisor has reason to believe that such a site of special biological significance may exist in the lease area, he shall give the lessee written notice that the lessor is invoking the provisions of this stipulation, the lessee shall immediately upon receipt of such notice comply with the following requirements: prior to any drilling activity or the construction or placement of any structure for exploration or development on lease areas in less than 200 feet of water, including, but not limited to, well drilling and pipeline and platform placement, hereinafter referred to as "operation", the lessee shall conduct site specific surveys, as approved by the Supervisor, to determine the potential existence of any uniques biological resource that may be adversely affected by any lease operation. If such surveys show anomalies that suggest the potential existence of a unique biological resource that may be adversely affected by any lease operation, the lessee shall:

(1) Relocate the site of such operation so as not to adversely affect the anomaly identified; or (2) establish, to the satisfaction of the Supervisor, on the basis of the site-specific survey, either that such operation will not adversely affect the anomaly identified or that the potential biological resource suggested by the occurrence of the anomaly does not exist.

All data obtained in the course of any biological surveys conducted pursuant to the provisions hereof shall be submitted to the Supervisor with any application by the lessee for drilling or other activity, with a copy to the Manager, Pacific OCS Office. The Supervisor will prepare a final report, a copy of which shall be supplied to the lessee. Should the Supervisor determine in his report, contrary to the contentions of the lessee, that the existence of a biological resource which may be adversely affected by such operation is sufficiently established to warrant protection, the lessee shall take no action that may result in an adverse effect on such resource until the Supervisor has given the lessee directions with respect to the resource.

The lessee agrees that, if any site, structure, or object of biological significance should be discovered during the conduct of any operations on the leased area, he shall report immediately such findings to the Supervisor, and make every reasonable effort to preserve and protect the resource from damage until the Supervisor has given the lessee directions with respect to the resource.

b. Notices to Lessees and Operators

These notices have the same effect or status as OCS Operating Orders and Regulations and are used when expeditious clarifications, corrections or additions to the orders and regulations are necessary. By issuing Notices to Lessees and Operators, the extensive amount of time necessary to amend and republish orders and regulations is avoided. Notices to Lessees and Operators which are currently in effect for the Pacific OCS area can be found in Appendix 6.

c. Waiver of OCS Orders

A departure (waiver) from OCS orders or other rules of the USGS Supervisor may be granted under 30 CFR, 250.12(b) when such a departure is determined to be necessary for one of the following reasons:

(a) the proper control of a well,
(b) conservation of natural resources,
(c) protection of aquatic life,
(d) protection of human health and safety,
(e) protection of property, or
(f) protection of the environment.

Waivers are technically based decisions and are granted in situations only where expert judgment determines that more efficient or safer operations would result from operations under the waiver. Under regulation the USGS area supervisor may approve minor departures from the requirements of the OCS orders but a request for a major departure will have to be approved by the Chief of the Conservation Division in Reston, Virginia. In practice normally all requests for waivers are directed to Reston, Virginia for approval.

d. Geophysical Information

The Conservation Division of the Geological Survey is aware of the near-surface structural features and its effects on the location of drilling platforms, pipelines, etc., relative to the proposed lease tracts. Knowledge of nearsurface structural conditions is fundamental to a sound lease management program for the OCS.

Geophysical data, which show the shallow geologic structures and sedimentary horizons, are used to predict, and thus minimize, any geologic hazards to drilling operations and consequent possible dangers to the environment from pollution. Surface and shallow subsurface geologic hazards, when properly identified, seldom create insurmountable obstacles to a minimal risk program of exploration and exploitation of economically attractive structures.

High-resolution geophysical data covering all tracts to be offered for sale will be purchased by the USGS and analyzed by their geophysical personnel. These data, in the area of coverage, provide definitive information on (1) thickness of the unconsolidated sediments (0-300'); (2) structural configurations of shallow seismic horizons (300-1500 feet below ocean bottoms); (3) sea floor topographic anomalies, mud mounds, mud waves or potential slide areas, pipeline and other objects on the sea floor and (4) bathymetry.

Information from these high resolution data are extremely useful in detecting shallow geologic hazards such as potentially unstable bottom conditions, etc. When these features are identified prior to drilling operations, or platform construction, the operator is notified so he can take the necessary action to assure that his operation is conducted with maximum safety.

Interpretations of high resolution bottom profile data, that disclose bottom conditions posing special environmental hazards for drilling or producing operations in the offshore area, will be made available to the Bureau of Land Management during the selected tract review process prior to the decision to issue a lease. Should the nature of geologic hazards on a particular tract warrant, a tract could be withdrawn from the sale or special stipulations could be attached to its lease at this stage. The District Engineer for Geological Survey could prohibit the placement of platforms on areas of instability should the need arise, through his authority to issue or not issue permits for platform placement. The Geological Survey will review proprietary data as well as non-proprietary data prior to the approval of drilling operations on a leased tract.

e. Conservation Practices

The Oil and Gas Supervisor, in the interest of conservation, is authorized to approve well locations and well spacing programs as the location of drilling platforms, the geologic and reservoir characteristics of the field, the number of wells that can be economically drilled, the protection of correlative rights, and the minimizing of unreasonable interference with other uses of the Outer Continental Shelf. The Supervisor draws his authority from Title 30, Part 250 of the Code of Federal Regulations and also the OCS Orders.

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V. Unavoidable Adverse Environmental Effects

As described in Section III.B. of this statement, certain features of oil and gas operations cause adverse effects which may be considered unavoidable in the light of current operation practices, technology, and regulations. A capsule summary of the significant effects from this sale are identified below. In addition, although oil spills resulting from this proposed sale can in general be avoided, some of the effects of an oil spill, if one should occur, are considered unavoidable and are also discussed below.

A. Effect on Marine Organisms

Several oil and gas operations result in temporary increases in turbidity. These operations include the discharge of drilling fluids and the excavation of pipeline trenches by jetting and dredging. The excavation of pipeline trenches in water depths of less than 250 ft. by jetting, dredging or possible blasting is unavoidable if pipeline safety and commercial fishing interests are to be served. Drilling fluid discharge is ordinarily another source of turbidity, but has been mitigated against. Pipeline laying will continue throughout the entire construction phase of operations or for at least thirty years. Actual corridor excavation will be sporadic throughout this period occupying less than 5% of the total working day and limited to areas near the mainland in shallow water (less than 250 ft.), excluding areas directly off Areas of Special Biological Significance (Graphic 4), and possibly excluding bays occupied by rare or endangered species (Graphic 3). The turbidity area caused by drilling cuttings, although unquantifiable, will be significantly larger than the 100 ft. diameter pile of cuttings caused by this operation. The drilling operations last approximately 30 days, causing a prolonged turbidity period of thirty to forty days. Although the impact on the plankton and benthos of the total Bight will be insignificant, localized destruction is unavoidable. When turbidity is generated near the water surface, the depth of penetration of sunlight is diminished. This leads to a decrease in the output of the photosynthetic mechanism of the phytoplankton. The dimensions of the area affected by pipeline burial are small and consist of a plume hundreds of yards in length. The duration of the turbidity in a given location will be several hours. The effect of any decrease in primary production must be considered adverse. The area involved is unquantifiable but very small and any reduction would only occur locally and would not involve the entire population of marine organisms. The impact of turbidity, by itself, will not have an effect on man.

Clogging of respiratory surfaces and filter-feeding mechanisms could reach a severe level in the benthic animals. The result of turbidity will be physiological stress and possible mortality. This impact will be encountered during pipeline jetting operations and will be restricted to the downstream direction of the ocean current. The duration of the impact in a given area along the more continuous path of the pipeline corridor will be no longer than a few hours, but if it occurs in shellfish beds, rocky shores, kelp beds, or similar concentrations of organisms the impact would be considered adverse. The duration of the impact caused by drilling fluids will be in excess of 30 days.

Beneath every platform where wells have been drilled is an expanse of cuttings, released during drilling, which has buried and smothered all non-motile benthic forms below it. If it is different in texture and composition from the surrounding sediment, it will not likely be colonized by the previous forms.

Resuspension of toxic pollutants within the sediments of certain areas and the resulting death to organisms or possible accumulation of toxicants in the food chain including animals eaten by man is another adverse impact. The most highly polluted areas include major portions of Santa Monica Bay, Palos Verdes Peninsula, San Pedro Bay and Newport Beach (See Graphic 3) or those areas closest to the lease areas in Santa Monica Bay and San Pedro Harbor. The amount of pesticides and certain heavy metals which will be accumulated in the food chain as the result of this operation alone will be slight and probably not affect man. However, these operations and resulting minor food chain accumulations could add to those from other non-oil related operations (agriculture or industrial effluents, dredging in contaminated sediments, etc.) which cause substantial food chain buildup and affect man who eats higher trophic level fishes which contain pesticides, mercury, carcinogenic agents, etc.

Exposure of biota to harmful or toxic materials, released into the marine environment or coastal wetlands such as from accidental spills of crude oil, fuel and solvents will bring about an unquantifiable adverse effect. Statistically, oil spills are inevitable. Table III-11 of Section III.A. estimates a range of 229,217 - 2,616,351 bbl. of oil spilled over the life of the proposal (60 years). This spillage estimate could be significantly higher if 20% of the production is tankered or barged for the high case production estimate (see Section III.A.). This spillage could be distributed as follows: a major spill of about 1.3 to 4.2 million gallons (30,000 to 100,000 bbl) resulting from a tanker spill, blowout or platform fire or explosion could occur every 7 to 10 years; minor spills of less than 2100 gallons (50 bbl) each could result in a spillage of from 200,000 to 1,700,000 gallons (4,758 - 41,010 bbl) of oil over the life of the proposal (60 years); medium-sized spills would occur throughout the life of the proposal at an undetermined frequency. Due to advancement of technology and the mitigating measures it is possible that the amounts and frequency of spillage can be cut substantially. The effects of crude oil and petroleum derivatives, depending on their concentration and composition, consists of lethal toxicity, sublethal effects, coating with weathered oil, behavioral changes, and habitat changes. The more subtle effects of light contamination may be serious also, but are not well understood at this time. Some specific types of these effects are:

1. Marine phytoplankton have been shown to suffer stress and mortality when exposed to oil during laboratory experiments.

2. Copepods have been found ingesting and passing oil droplets without apparent harm. The copepods, however, serve as an important link in the food chain between phytoplankton and larger animals and ingested hydrocarbons are therefore passed on to larger organisms indicating the possibility of at least temporary food chain magnification.

3. All marine plankton present near the core of the plume of formation water, before it is sufficiently diluted by sea water, will suffer stress or mortality from concentrations in the plume. This adverse effect will be immeasurably small at the population level.

4. Laboratory experiments show that fish may be killed during the egg and larval stage after exposure to crude oil. Respiratory surfaces become clogged and damaged in juvenile and adult stages. These effects would occur if spills come in contact with eggs and larvae in the breeding zones resulting in a significant decrease in population in those areas involved.

5. In the event of an onshore oil pipeline leak or spillage on an onshore facility, vegetation would be affected according to the severity of spill. A small leak may do little damage. A severe leak, however, may contaminate the substrate and kill the vegetation that comes into direct contact with the oil and several years may be required for recovery. Small animals in contact with the oil would likely be killed, the numbers ranging from an insignificant number of the population through a total kill of the oiled species. Rare endemics within the area having a restricted geographical range could become extinct, while most populations of the abundant species with a wide geographical range would recover biologically in five years or less.

6. Review of the Santa Barbara oil spill indicated that the probability is high that if a large spill comes ashore, large numbers of shorebirds, wading birds, and waterfowl will be killed. The threat to endangered species is considered minimal unless an oil spill penetrates an estuary. The probability of this is considered low due to the small number of estuaries in the sale area and the fact that all but one have narrow entrances. However, in the event that a spill did enter an estuary the probability that it would impact upon one or more endangered species or their habitats increases. Any impact of this nature would be considered adverse and significant.

Although the potential for harm is present, the inability to predict accidental oil spills or frequency, amount, location, and duration makes an assessment of the scope of the effect on birds uncertain. The severity of kill depends upon the size of the spill, the area it covers and the season of year. Vulnerability is greatest during the spring nesting and migration period and fall migration peak. Other variables include type of beach oiled (rocky shore or sandy beach), the location with respect to urban areas (Graphic 5 and 10) and proximity to bays and marshes (Graphic 3).

7. Temporary or permanent abandonment of breeding rookeries by pinnipeds on San Miguel Island due to drilling operations three miles from the rookeries will be a highly probable, although not proven, occurrence. A spill reaching shore during pupping season may have severe detrimental effects on nursing pups (see Section III.C.3.).

8. Much of the oil from a slick suspended over a shallow area of the pristine and relatively unknown benthic communities of Cortes or Tanner Banks would be forced by the surf to the bottom and oil the bottom communities. Sensitive members of these communities will be killed, some species may even possibly be eliminated from the banks (see Section III.C.2.).

B. Wetlands, Beaches and Channel Islands

If an oil spill impacts upon a sandy beach, a condition will result which may last from weeks to several years or more, depending on the amount of oil and size of the area impacted. Since about 80% of the coastline is classified as sandy beach, the probability of a spill reaching a sandy beach within the area is approximately 0.80 but only about 0.10 on the offshore islands. The reciprocal probabilities would apply to rocky shores. See graphic 10. The size of the beach affected can vary from less than a mile to 48 miles depending upon the conditions in the area at the time. Heavily contaminated beaches will be rendered unsuitable for recreation so long as they remain contaminated with oil. Based upon the literature, an insignificant amount of damage will occur to the sandy beach community. This, however, does not preclude more severe effects from a large spill during the summer or from chronic effects from sublethal dosage of crude oil over years of exposure. The extent and magnitude of these possible effects are not presently known.

If mechanical means are employed in beach cleanup operations (bulldozers, front end loaders and other earth moving equipment) as was done following the Santa Barbara and Arrow oil spill incidents, then shoreline equilibrium may be upset by beach removal. Excessive removal of beach materials can lead to erosional problems unless enough sand and gravel, for example, are available to replace the removed beach materials.

If a large oil spill impacts upon a rocky shore, an adverse effect greater than that on sandy beaches will occur. The direct death from smothering of intertidal organisms will be greater than that on sandy beaches, and be as high as 100% for certain upper intertidal species. Cleaning of surfaces with hot water spray, as was done in the Santa Barbara blowout, will completely eliminate the community from the sprayed area, and biological recovery will require as much as five years. The hot water will cause less biological destruction than oil. However, if toxic components of oil do reach shore, extensive destruction could occur and complete biological recovery could take the same amount of time.

Much of the area defined as Areas of Special Biological Significance (ASBS) was based on highly productive or unique intertidal areas, although these significant areas usually extend to subtidal areas as well. With oil platforms three miles away, an oil spill would have a relatively good chance of contaminating a state defined ASBS which, by definition are "areas containing bilogical communities of such extraordinary, even though unquantifiable value that no acceptable risk of change in their environments as a result of man's activities can be entertained."

Although, because of the rather narrow entrances, accessibility of booms and other oil trapping equipment, and scarcity of estuaries of this type, it is unlikely oil from a large oil spill will enter one of the relatively unaltered estuaries (Mugu Lagoon, Anaheim Bay or Upper Newport Bay) in the proposed lease area. The entrance of oil could cause extremely adverse biological impacts, including: elimination of several endangered bird species (clapper rail, lease turn, or Beldings savanna sparrow), and certain temporary and permanent floral and faunal species from the oiled estuary.

In addition to possible rookery abandonment by pinnipeds (mentioned in section V.A.) construction facilities on the channel islands (particularly San Miguel, San Nicolas and San Clemente) would result in loss of a relatively pristine upland habitat which is presently occupied by various endemic species of plants and animals as well as several rare or endangered species (see Section II.F.6.).

C. Deterioration of Air Quality

In the process of recovery and transporting resources from offshore, various types of air emissions will occur. Because of the distances from shore, the moisture content of the air, and the existing wind patterns, the air around specific offshore locations will be impacted by a minor amount and for a slight duration of time. The onshore air spaces will not be impacted by normal offshore activities, but in the event of a large scale oil spill or fire, the area will have a significant impact. Additions to the onshore air pollution will result from normal operating procedures of storage, treatment, and terminal facilities that will be built. The added increase of offshore operations, according to the Air Pollution Control Districts, will add far less than one percent to the existing air quality and will be within the allowable standards.

In a natural gas leak or gas well blowout degradation would be small since the methane pollutants would volatilize quickly and drift away; however, some reative hydrocarbons (RHC) will be emitted into the air. If a fire results, emissions would consist mainly of carbon dioxide and water vapor.

Oil leaks and oil spills, not accompanied by fire, produce pollutants of lighter ends which are the more volatile components of crude oil. Their degree of degradation is unknown, but it is estimated that the amount of RHC on shore would increase by half in the case of a large spill of 100,000 bbls. If the spill results in a fire, large amounts of particulate carbons and oxides of carbons together with unknown amounts of sulfur oxides, nitrogen oxides, evaporated crude oil liquids, and partially oxidized compounds would enter the air. Local air quality would be degraded during the period of the fire by the addition of particulate matter. Should a fire occur, and depending on its location offshore, air quality degradation would be considered more of a nuisance and would be harmful only to the extent of soiling when settling to the ground. The added air pollution will have a negative impact on agriculture and human life.

D. Deterioration of Water Quality

During the construction of pipelines (possibly 150-900 miles) and structures (platforms) and during the drilling operations, bottom sediments will be put into suspension. As a result of increased suspended sediment, the light attenuation will increase accordingly. This turbidity effect will be short term and have a minor effect on water quality. During drilling operations if drill cuttings are not cleaned of toxic chemical contstituents (drilling muds), or if polluted cuttings are accidentally discharged into the marine environment, potential adverse water quality degradation can be expected. Known water quality hazards (from drilling muds) result from caustic soda and Ferrochrome lignosufonate with barium being a potential threat in water quality. The effect of clean and/or polluted drill cuttings can be mitigated if cuttings are barged to onshore disposal sites.

If bottom areas of high pollutant concentration are not avoided pollutants will be reintroduced into the water column with the suspension of sediments (due to construction and drilling operations). Areas which receive high amounts of pollutants are seen in Figure V-1 (Crosshatched areas are major ocean outfall service areas). Deposits of pollutants, other than those adjacent to major ocean outfall service areas, may be found along the entire Borderland coastal shelf and adjacent basins and/or sills where low current dynamics are present. Areas which contain pollutants could have chemical constituents that have been concentrated over the past years. These constituents could then result in concentrations greatly in excess of accepted federal (EPA)

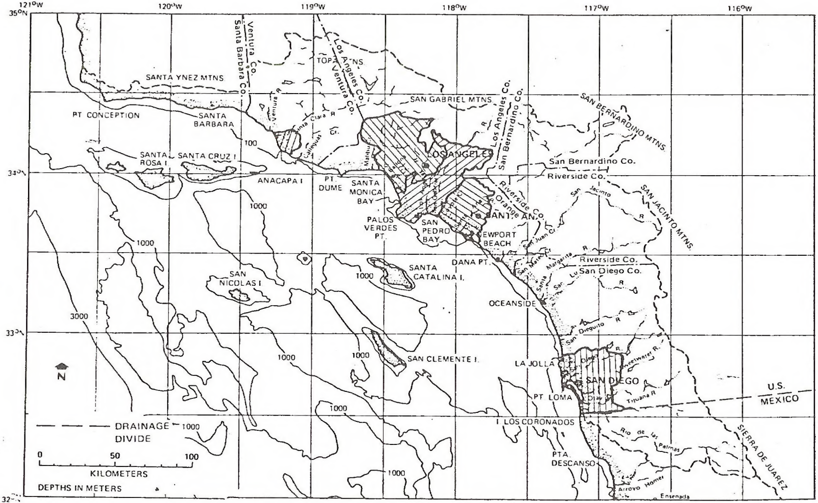

Figure V-1. Major Ocean Outfall Service Areas in the Southern California Coastal Basin. (SCCWRP, 1973).

and local government discharge dumping requirements. The impact on water quality as a result of this proposed action can range from a low order insignificant effect to a highly significant effect.

Treated sewage may have a significant effect on the water quality in the immediate area of sewage discharge, but if treated properly and discharged with proper diffusion, minimum water quality deterioration is expected. This impact will be from the treated sewage effluent exerting a slight increase in the oxygen demand, nutrients, residual chlorine and turbidity. To eliminate this effect, holding tanks with land disposal or a more refined treatment system (although probably not economically possible) could be implemented.

Formation waters (oil field brine) if not properly treated will contribute significantly to the deterioration of water quality. Components or properties of formation waters which may contribute to water quality degradation when released into the ocean can be: entrained liquid hydrocarbons, dissolved mineral salts, and absence of dissolved oxygen. Although we know of no studies that have been conducted to describe the synergistic effects of constituents within formation waters and/or possibly in conjunction with constituents from municipal and industrial waste waters, it is notable that the potential for synergistic effects from formation waters is possible.

During the production life of an area many wells will be drilled from one platform. Since some of these wells will be from formations formed during different geological times under different environmental conditions, chemical and physical properties of the formation waters from a platform will change as new wells are drilled and the old wells are abandoned.

Since many factors as described above contribute to the physical and chemical characteristics of formation waters, the only way that potential pollution can be detected and then controlled is by periodically monitoring of the effluent waters. Without such controls the formation waters represent a potential significant hazard which will degrade the water quality and thus have deleterious effects on the marine biota.

To eliminate formation waters effect on the marine aquatic environment, the Federal Water Pollution Control Act Amendments of 1972 (P.L. 92-500; 86 Stat. 816) makes the discharge of any pollutant by any person, except in compliance with certain sections of the Act, unlawful. Presently the EPA, Regional Office (IX), is issuing permits for the discharge of formation water effluents. A copy of a recent permit (public information) is shown in Appendix 27. From this permit it is noted: If the results of the monitoring programs (Appendix 27) so indicate, the Regional Administrator may, upon due notice, impose such permit conditions, including but not limited to effluent limits, as he determines are necessary to carry out the provision of the Act, or amendments thereto.

This action by EPA should enhance the non-deterioration of the marine water quality due to formation water discharge, if the effluent limitations and monitoring requirements, such as in Appendix 27, are fulfilled.

It is notable that the permittee has requested an adjudicatory hearing which may result in modifications of the permit.

Moderate to severe water quality degradation will occur as the result of an accidental oil leak or spill. Potential large spills resulting from proposed oil operation can be of the same order of magnitude as the 1969 Santa Barbara oil spill (100,000 bbl; 4.2 million gallons). Oil which will adversely effect water quality is that which is not contained or recovered by oil spill contingency activities.

As of this time no tests have been conducted which show the efficiency, i.e. percent oil recovered from open ocean, of an oil recovery system. Containment has been shown to operate in seas of 6 foot high waves with currents of 2 knots. The amount of oil which is contained and recovered will depend on the above containment and recovery efficiency, time differential between oil spill and initial containment-recovery actions, and oceanic and atmospheric conditions.

Factors contributing to the impact on water quality from oil spills and leaks are: potential for dispersion of oil spill, direction of oil transport, present degree of water quality, potential to absorb oil into water column without exceeding an arbitrary threshold and possibility of pollutants reaching maximum acceptable concentrations. The deterioration of water quality as a result of the above factors, on possible locations of oil spill impact, are shown in the Table of Probable Trajectory and Impact Potentials (Section 111.F.2.).

Tests performed on oil show that aromatics are the most toxic, nephthenes and oleiins are intermediate in toxicity and straight paraffin are the least toxic compounds found in oil. Heavy metals, depending upon the oil producing formation, may also be released to the ocean through an oil spill. Besides oil being toxic, it may also act as a mobilization mechanism for chlorinated hydrocarbons.

E. Interference with Commercial Fishing Operations

Implementation of the sale would have some adverse impact on the economics of California's commercial fishing industry. This would occur in three principal ways: (1) biological effects causing reduced catches, unmarketable catches, or the closure of fisheries due to oil pollution; (2) physical effects, such as gear losses; and (3) diversion of capital and labor. These effects could occur, but their magnitude cannot be accurately predicted because of the variables of location and timing and other factors.

As described in earlier sections, future trawling operations and present purse seining operations suffer interference and inconvenience from oil and gas operations in several ways. A small portion, up to 0.3% of each tract leased, of sea floor is occupied by drilling rigs and platforms and is unavailable to trawl fishermen. Determination of the area lost to purse seining operations is far more complex because of the long period of time spent drifting completely at the mercy of the winds and currents. At this time, we can only say there is an impact. Trawl and purse seine nets become snagged on underwater stubs and unburied pipelines, causing damage to, or loss of, the nets. Less frefrequently, large objects lost overboard off petroleum industry boats and platforms are caught in nets, resulting in damage to the net and/or its catch of fish. The frequency of occurrence of this type of incident is unknown. Since fishing data reported in southern California cannot be compared with that of other areas, and since conditions differ from those of the Gulf of Mexico, it is not possible to estimate the frequency or cost of lost equipment.

Although commercial fishermen could be expected to avoid the area of an oil spill, spilled oil could coat or contaminate commercial fish species, rendering them unmarketable. Even though tainting of a fishery product might occur infrequently and affect only a localized area, a single such incident could adversely affect marketing of similar fishery products from adjacent areas over an extended period of time. This indirect effect, resulting in loss of market advantage, could be more damaging to the fishermen and processors than extensive direct mortality of a resource. Markets once lost for this reason could be difficult to regain.

As indicated in Section III.E., a large case 2 spill could preclude the landing of 4.75 million pounds of fish from capture and at least a loss of $184,600 to the fishermen from the area covered by oil. This may not be representative of the catch actually lost because, among other variables, it does not consider an increase of effort outside the oiled area.

Due to a major oil spill or chronic minor oil spillage, commercial and recreational harvest of particular intertidal shellfish would be restricted and perhaps lost entirely for unknown lengths of time due to a combination of lower quantity and quality, the conflict between fishing operations and vessel traffic, and possible closure to fishing due to the health hazard of tainted products.

F. Interference with Ship Navigation

Very little, if any, interference would occur between the estimated fourteen to sixty platforms and vessel traffic within the 2,425 square miles of the proposed lease area.

The possibility of vessels colliding with a platform is considered remote since the majority of the offshore facilities will be located several miles from shipping lanes and will be equipped in accordance with the United States Coast Guard regulations. In addition, platforms represent an ideal reflector for shipboard radar navigational systems.

Vessels carrying waterbourne commerce will follow the sea lanes which will provide vessels with a safe avenue of approach to and departure from the ports. (See Volume 2, Section III.G.)

To assure minimum navigation interference in the sea lanes from offshore oil drilling activities, all oil drilling and production operations in the vicinity of the sea lanes will be restricted by the U. S. Coast Guard and the U. S. Corps of Engineers.

Small boat traffic will be in the area of the platforms, but should not receive any interference from the structures. The small craft use will generally be limited to daylight hours when visibility is adequate for lined sight navigation. In addition, the approximately fourteen to sixty platforms will only use a small portion of the lease area thereby further minimizing interference with ship navigation.

G. Damage to Historical and Archeological Sites, Structures and Objects

Unavoidable damage to historical values will occur when structures are not preserved or are not identified in time to take action for their preservation. Alteration of the surrounding environment of an historic site or structure would be an unavoidable impact if the developer possessed or took no other option for a development site.

Archeological sites or artifacts may not be detected with total certainty by surveys. Those which remain undiscovered will be damaged or destroyed partially or wholly if excavation occurs. When an archeological site must be excavated because no other site option exists, then some values which might accrue to a future investigator due to greater knowledge and more sophisticated analytical techniques and equipment, are permanently lost. Concealment of finds by contractors could also result in their destruction. The duration of these impacts would be permanent. The incidence of damage on the continental shelf is likely to be low, but is potentially higher in the coastal zone.

Other damage to archeological resources could come from oil contamination. Historical and archeological materials soiled by an accidental oil spill may not survive subsequent cleaning and restoration efforts. Porous materials could be rendered unsuitable for carbon dating techniques. The probability of such a polluting event occurring and interacting with artifacts is low and the potential for significant resource destruction appears small, although it does exist.

H. Interference with Recreational Activities

Certain unavoidable impacts on the recreation resource within the southern California Bight area will occur during the exploration, construction, and operational phases of the proposed project. The impacts will affect both the onshore and offshore uses and activities and will be temporary in duration. In addition, the impacts to recreation will be more disruptive in nature and be a nuisance to the participants.

During the exploration phase, the main impact will be caused offshore by the introduction of added vessels into the lease areas. Since the vessels will operate from the Los Angeles-Long Beach ports, the impacts will occur between the ports and the five offshore areas. As a result, the beaches and nearshore recreation areas will not be impacted. The major recreational activities being disturbed or disrupted are boating and sportfishing. Since the exploratory vessels will traverse the lease areas, the recreational activities will be disrupted only for short periods of time.

During the construction phase the recreational resources will be impacted the greatest amount with the exception of a major oil spill which could also occur during the operational phase. Since oil production activities will peak by 1987, the impacts during this phase can occur for several years and even overlap those noted for the production phase.

Associated with construction activities will be an increase in vessel traffic, offshore and onshore pipelaying activities, water turbidity, the movement of fish from one location to another on a temporary basis, and a visual disruption for given periods of time. As indicated, the impacts will be temporary in time and disruptive in nature. The main impacted activities will be fishing, diving, and swimming mostly due to increased vessel traffic and water turbidity. Onshore active and passive types of recreation may also be disrupted if pipeline construction occurs on recreation sites or in close proximity. This will result in both a quantitative and qualitative drop in the recreation resource. The impact will be of short duration since water turbidity has a fast settling rate and since pipelaying operations on beaches is accomplished very rapidly. With the drop in attendance at one site is a corresponding increase of attendance at another site, thus raising the possibility of a temporary overcrowding at other sites. Again, the visual effects coupled with the associated noise, dust, odors, and vibration found with construction activities will generally lower the recreational desirability of the site.

During normal operations of offshore oil and gas production the main impact on recreation will occur offshore. The added volume of offshore activities and vessel traffic and movement may be disruptive to sportfishing activities in all five lease areas, particularly those in Santa Monica Bay, San Pedro Bay, and the two in proximity to the Channel Islands.

The visual impact will be greatest particularly in Santa Monica Bay and San Pedro Bay where the greatest amount of beach users are involved. Since the major activities will be at least 3-3/4 miles offshore, the impact will be lessened by the distance factor.

The presence of offshore oil structures will also enhance the recreational fishing potential. The structures serve as new habitats for the fishes and create areas of new fishing possibilities.

The main impact on recreation certainly would be from an oil spill or leak which might wash upon the shoreline. The impact will be disruptive and will close some areas during the cleanup and restoration period.

The most significant unavoidable adverse effects for sport fishing in Southern California would result from a major oil spill. An oil spill would preclude sport fishing in the area of the spill for at least the duration of the spill, and until clean-up operations or natural processes remove the oil. In addition, adverse publicity from the spill would probably prevent sport fishing in the area from returning to normal levels for a time after the spill is cleaned up. For example, as discussed in Sect. III.1.5. for the Santa Barbara blowout in 1969, landings of sport fish in Santa Barbara for the six month period of February to July were only 10% of the landings in comparable six month periods during the previous four years. Furthermore, actual contamination of fish or associated bait organisms by oil, or the fear of contamination, could keep sport fishermen away from an oil spill area for a considerable time. Shoreline and surf fishing would be reduced in areas where a spill impacted on the shoreline for the duration of a spill.

Placement of platforms and associated offshore facilities would result in a temporary withdrawal of areas for sport fishing. However, the increase in habitat for fish provided by offshore platforms, once they are in place, could compensate for the temporary loss and result in increased private boat fishing around the platforms.

There are several unavoidable adverse effects which will affect recreational boating as a result of the proposed sale. Either the risk or the impact will persist throughout the life of the leases, if issued, and end with their abandonment. This could range anywhere from 20-40 years.

Increased traffic in harbor areas and associated sea lanes could make pleasure boating less enjoyable and potentially more hazardous. This would be particularly true if barging is used to transport significant portions of the production. Platforms could constitute an obstruction to boats under certain conditions. The change in the character of the open sea caused by the presence of platforms would constitute an esthetic impact for boaters. Slicks, both large and small, appear to be unavoidable consequences of offshore oil production. Small slicks would have an esthetic impact and could also stain boats or foul fishing gear if inadvertently encountered. A large slick such as that which attended the 1969 Santa Barbara blowout would cause disruptions in recreational boat usage and patterns of use. Closure of harbors to prevent oil incursion could result in prevention or restriction of boat use for periods of 3 weeks or more. A Santa Barbara size spill in Santa Monica Bay or the San Pedro area could close all marinas thereby resulting in losses in excess of 12,000 boating days.1/

1/ Boating day is defined as the use of the vessel for any portion of a day.

Small slicks such as those which persisted in open waters for weeks following the Santa Barbara spill would inhibit recreational boating resulting in a loss of several more thousand boating days. In total, each event of this magnitude will likely result in a loss of 50,000 - 100,000 participation days.

I. Degradation of Esthetic Values

If platforms are permitted in Santa Monica and San Pedro Bays, a large visual impact will exist until about 2020. Visual impacts will be large for boaters in the Santa Barbara-Catalina tracts and for visitors to Santa Barbara Island. Visual impacts will be lower on the Outer Banks because of lower visitation rates. Adverse esthetic impacts will occur if pinniped colonies are destroyed because of activity on or near the islands of San Nicolas or San Miguel. The northern tracts of the Santa Rosa-Cortes North Block have this potential, particularly if they precipitate drilling in state waters as a result of drainage. Loss of some solitude is unavoidable.

Onshore treatment and storage facilities, communication sites and equipment yards will produce visual, audio and olfactory impacts, the degree depending upon siting, landscaping, emission and sound control efforts. Changes in land use from undeveloped to industrial are inevitable. Scars due to earthwork will be visible in some cases. Construction of piers or jetties may be considered adverse impacts by some.

Oil spills are inevitable and assuredly adverse both at sea and on beaches or rocks. It is certain that a minimum of tens of thousands of visitor days will be affected by oil spills during the life of this proposal. Ecologic values comprise one of the main attractions at Santa Barbara Island. A spill which affected these living communities would seriously degrade the esthetic value of this portion of the National Monument. Oil drainage could pressure the state into leasing state lands around the island.

J. Conflicts with Other Uses of the Lands

Land use conflicts fall into two categories. The first involves short term conflicts while the second is concerned with those conflicts having a greater time duration. Short term conflicts will occur during the construction phase of pipelines and other processing and transporting facilities. The types of conflicts with surrounding land uses includes disruption from earthwork movement, noise, vibration, odors, increased traffic, and the addition of particulate matter into the air. Trenches for pipelines will be covered and normal vegetation will be restored, and the noise and associated disturbances of construction will cease once the first phase is completed.

The long term conflicts with other land uses are varied. The major impact is that new facilities set the pattern for future land uses in an area. The degree of conflict will be minimized since facilities will be located in appropriate land use zones which are permissive in allowing only similar types of development. The visual and odor impacts of facilities will be long term in nature because of standard operating methods. Normal transportation requirements of the industry will introduce an added volume of movement onto the existing network of streets and highways both on the local and regional level. The added use requirements for public utilities will be long term with the method of adverse impact being measured only by the adequacy of the particular utility to supply the new needs without cutting back service to other surrounding land uses.

K. Summary

In summary, most unavoidable adverse impacts that will be sustained by the natural environment as a result of routine operations will be relatively localized in their effects. Many will be followed by unhindered natural recovery within time periods of less than 10 years. A major unavoidable adverse effect of permanent duration could be the abandonment of the pinniped rookeries on the Channel Islands if construction and development activity takes place near these fragile areas. In addition to possible abandonment of pinnipeds, construction of facilities on the Channel Islands (particularly San Miguel, San Nicolas and San Clemente) would result in loss of a relatively pristine habitat which is presently occupied by various endemic species of plants and animals as well as several rare or endangered species (see Section II.F.6.).

An oil spill could contaminate a State defined Area of Special Biological Significance which, by definition, are "areas containing biological communities of such extraordinary, even though unquantifiable, value that no acceptable risk of change in their environments as a result of man's activities can be entertained."

A massive oil spill accident would result in a significant adverse impact; it is likely that such a spill will occur, however, the occurrence interval is unknown. Small chronic spills may result in subtle adverse effects, the extent of which is unknown.

VI. Relationship Between Local Short-Term Use and Maintenance and Enhancement of Long-Term Productivity

The principal short term use of the area will be for the production of oil and gas nonrenewable resources. Oil and gas will be produced and used now and will not be available for future use. It is estimated that the amount of recoverable resources range between 1.6 and 14 billion barrels of oil and a range of natural gas from a low of 1.5 to 2.0 trillion ft.^{3} to a high of 14.0 to 28.0 trillion ft.^{3}

To date, there has been no discernable decrease in marine productivity in OCS areas where oil and gas has been produced for many years. However, it has been recognized that continuous low level pollutions from toxic chemicals, including oil, may adversely affect long term productivity. Until reliable data becomes available, the long term effects of the incremental and major spillage of pollutants cannot be accurately projected.

Several potential questions exist as to the short term use of the project and the long term productivity of the marine biota. Some endemic organisms with a restricted range may become extinct if an environmental disbalance occurred within their habitat. Other species, having a massive population, can repopulate without any adverse effect. Areas of special biological significance could become severely damaged or lose their special significance by the project. Again, the pristine environment of the Channel Islands could be changed by prolonged or frequent chronic oil spills or by the presence of onshore operations on the islands themselves.

The presence of the project may have an impact on the long term productivity of the biota with the introduction of human activities into the area. The nesting habits of birds or the mating activities of pinnipeds may be disrupted to the point that a lower reproductive success may result or that the species may be permanently driven from the area. Wintering species of birds may also be forced to less suitable habitats. Oil spills may decimate migrating populations of birds which stop at the Channel Islands enroute to other places.

The onshore impacts can result in long term implications. For example, onshore land use requirements for petroleum facilities will require approximately 100-200 acres of land in the Ventura County Area. As a result of the requirements, it is possible that the 100-200 acres may be taken out of agriculturally used lands (see Section III.J.1.). The result is the transformation of land from one use to another. The long term affect is that the transformation may provide the needed step for added urban expansion which in turn will lead to the conversion of other agriculturally used acres. The change from agriculturally used land to an oil industry type use will substantially increase property tax revenues for local government, but will result in the loss of receipts from the sale of agricultural products.

Disturbance of coastal land from pipeline construction and burial operations will decrease productivity for the short term only. The productivity of coastal lands in the area of pipeline operations will temporarily decrease following the disturbance, but will return to normal levels as original conditions are restored. The short term losses will be the disruption of vegetation, terrain, wildlife, vehicular traffic flow, and the introduction of odor, vibration noise, and air pollutants in proximity to the location.

The effect on port and shipping facilities will be short term and will end generally with the completion of the well drilling phase of operation. The existing ports in the area will be able to accommodate the increase and will not need to provide additional facilities to meet the demand.

Long term impacts, including possible extinction of endemic species, may result from oil spills in the project area. Some disturbance will occur which will be disruptive in nature both offshore and onshore, but recovery and regeneration generally occurs in one to five years.

With respect to short term uses and long term productivity, it should be noted that impacts may affect the economy and pattern of growth of the area. At the present time, no economic or social conflicts can be foreseen which would constiture a significant consequent. Any effects are expected to be minimal and will peak by 1987 and reduce at a rapid rate after that time.

VII. Irreversible and Irretrievable Commitment of Resources

A. Mineral Resources

Leasing of the proposed tracts in this sale would permit development and extraction of the minerals contained therein.[1] Estimates of recoverable reserves for this potential lease area vary sharply depending on the source of the estimate. United States Geological Survey (USGS) estimates net recoverable reserves of 1.6 to 2.7 billion barrels of oil and 2.4 to 4.8 trillion cubic feet of gas. Western Oil and Gas Association (WOGA) estimates 14 billion barrels of oil and 28 trillion cubic feet of gas. Leasing the proposed tracts could represent an irreversible and irretrievable commitment of resources.

B. Land Resources

The land resources requirements for this proposal is expected to total approximately 400 acres in addition to corridors for pipeline construction. Two hundred acres probably will be in Ventura County and will represent a change from agricultural use to urban use. The development will serve as the nucleus for additional development which will remove other lands from agricultural use thus expanding urban encroachment. The remaining two hundred acres will be in the San Pedro-Long Beach area within the existing industrial complex. The pipeline corridors will total approximately one hundred miles in length and will probably be in proximity to other pipeline rights of way. If additional corridors space is required, then development

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1/ More than one mineral lease may be issued for the same area for the retrieval of other types of minerals but CFR43, Part 3307, 4-5 provides that other leases may not unreasonably interfere with or endanger operations of any existing lease.

restrictions will apply on the rights of way surfaces. The restrictions will render the land undevelopable thus maintaining an open space status in the future.

C. Fish and Wildlife Resources

An irreversible or irretrievable commitment of certain species of fish and wildlife resources and their habitats could occur in the area of a massive oil spill or if frequently subjected to chronic low levels of oil pollution. At this time, there is insufficient evidence to conclude that low-level spillage has led to an irreversible commitment of fish and wildlife resources but there is enough evidence to indicate that this is a possibility that deserves close attention, and constant study.

D. Energy Resources

The energy resources committed will be those expended for exploration, development, production, transportation and refining plus the amount expended due to processing losses. The efficiency of end-uses and of the indirect energy requirements is not considered here. End-use is not considered because of the impossibility of tying the production to a specific one, and indirect requirements are not considered because they will be primarily marginal (with an inadequate data base to calculate from) and because a large proportion of the indirect inputs are sunk costs.

These committed resources will then be contrasted with expected recoverable reserves to arrive at an estimate for the net energy gain resulting from this sale.

From the EIS, recoverable energy could range from $11.76\text{-}20.9 \times 10^{15}$ Btu. Of this $9.25\text{-}15.66 \times 10^{15}$ is oil and $2.47\text{-}95 \times 10^{15}$ is gas. The energy necessary for finding, producing, transporting, and processing the resources is known as ancillary energy. The part recovered of the amount of energy (reserves) in place is known as primary efficiency.

1. Oil

The primary efficiency does not apply to exploration and development. For production, it has historically been about 30%; hopefully, the figures given above already include this factor. It may rise due to technological improvements such as better secondary and tertiary recovery methods. Some estimates are that it could reach 70%, but this factor will not be included here. The primary efficiency of transportation is 99%, allowing 1% for leakage. This brings the net down to 9.16 - 15.5 x 10^{15} Btu. The primary efficiency of refining has been calculated to range from 88 - 96%. 1/ Ninety-two percent will be used here, reducing net recovered energy to 8.42 - 14.26 x 10^{15} Btu. What happens after the production leaves the refinery is beyond the scope of this statement; therefore, the above figures will represent the total energy recovered. As previously mentioned, end use efficiencies will not be considered.

To get the net energy gain resulting from this sale, this figure has to be discounted by the ancillary requirements.

Figures for exploration, development and production are not available, but are sufficiently negligible so that an assumption can be made that they will be equal to 10% of the recovered energy. The production inputs would increase significantly if secondary and tertiary recovery methods were employed; but since the resulting improved recovery was not included, the added expenditures won't be either. Discounting the recovered petroleum based energy reduces it to 7.58 - 12.83 x 10^{15} Btus.

For transportation, figures for five diffferent modes have been calculated. 2/

1. Energy Alternatives: A Comparative Analysis, University of Oklahoma 1975.
2. ibid.

Since we are talking about the OCS, and we stop at the refinery, we'll assume all refineries are on the coast and that only pipelines and/or barges will be used. The pipeline parameter is 3.59 x 10^9 Btu per 10^{12} Btu piped 300 miles. For barges, the parameter is 25.2 x 10^9 Btu per 10^{12} Btu shipped 1500 miles. The EIS estimates 450-700 miles of pipeline will eventually result from this sale. For simplicity, 600 miles will be used in the calculations. Furthermore, an 80-20 distritution between pipelines and barges is assumed. This being the case, transportation will consume .073 - .124 x 10^{15} Btus. Therefore, the net gain is now reduced to 7.50 - 12.7 x 10^{15} Btus.

The ancillary energy consumed by the average refinery is 59.8 x 10^9 1/ Btu's per 10^{12} Btus refined. This figure was included in the percentages used earlier, so an additional calculation is not necessary.

2. Natural Gas

Furthermore, in the case of natural gas, an historical average of 3.4% has been lost through venting, flaring etc. on the OCS. 2/ This would reduce natural gas to a net gain of 2.39 - 4.78 x 10^{15} Btus. Additionally, some natural gas is used (about 4%) to drive the compressors on a gas pipeline. 3/ This works out to .09 - .19 x 10^{15} Btus, reducing the gas net to 2.29 - 4.59 x 10^{15} Btus. Ancillary costs associated with exploration, development and production are assumed to be included in the figure for petroleum. At this point, the total net gain is 9.99 - 17.29 x 10^{15} Btus.

1. Oklahoma, op. cit.
2. ibid.
3. ibid.

As mentioned above, it is infeasible to try and quantify the energy required by indirect inputs into the subsequent development of the leases. However, estimates have been made as to the numbers of wells, pipelines, work boats, platforms and other facilities resulting from sale. The prime component of all these, and the primary indirect energy consumer, in the petroleum industry, is steel. Parameters have been developed to calculate how much steel will be required. Then the energy consumed in making the steel will be applied and the whole thing subtracted from the net gain to five a final surplus over consumption which should be reasonably complete, granting the accuracy of the estimates and assumptions used throughout this section.

The EIS for sale #35 shows the following estimates of necessary facilities:

Wells	
--producing	800 - 4975 (3000)
--exploratory	60 - 480
Platforms	14 - 60 (45)
Miles of Pipeline Corridor	150 - 900 (600)
Terminal/Storage Facilities (onshore & offshore)	2 - 15 (11)
Support/Supply Facilities (onshore)	1 - 3 (2)
Pipeline Terminals	1 - 3 (2)
Floating Processors	0 - 7 (5)
Fleet	0 - 35 (17)

The numbers in parentheses are the assumed figures that will be used in our calculations to keep them manageable.

For wells, assuming 3000 with an average depth of 5000 ft., and using a parameter of 11.25 tons steel per steel per 1000 ft.[1], the total steel requirement will be 168,750 tons.

For the 600 miles of pipeline we assume a 16" diameter pipe, with a .438" wall. Approximately of 200 tons of steel 2/ per mile is necessary for this size, resulting is requirements of 120,000 tons.

For 45 platforms, we assume 30 will be in an average water depth of 100', 15 in 600'. The parameters are respectively, 5,100 tons and 11,900 tons. 3/ The total steel is 331,500 tons.

For the work fleet of 17, we assume 1500 tons per unit, resulting in a total of 25,500 tons.

The subtotal for the steel requirements for processors, support facilities, and storage facilities are not readily available. Therefore, for the sake of simplicity, we will assume a total of 354,250 tons. This brings the grand total of direct steel requirements of this sale to an even million tons.

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1. USGS
2. Offshore magazine, March 1974
3. Hogan, W. Economic History of the Iron and Steel Industry in the U.S. (Heath, Lexington, 1971)

Applying a parameter of 7.86×10^7 Btu ton to this results in an energy input of $.079 \times 10^{15}$ Btu: the parameter is the energy content of alloy steel; it does include some indirect inputs such as mining, coking, transportation and the like. Furthermore, it is a national average of all steel; the specialized oil country goods require more processing, but, alas, individualized parameters are not available.

Be that as it may, the net energy gain is now reduced to $9.72 - 17.11 \times 10^{15}$ Btu.

Reconverting this to standard hydrocarbon measures results in a net gain from this sale of from $1.29 - 2.18 \times 10^9$ bbls of oil and from $2.19 - 4.42 \times 10^{12}$ cubic feet of natural gas.

1. Oklahoma, op. cit.

VIII. Alternatives to the Proposed Action

A. Hold the Sale in Modified Form

1. By Considering Withdrawal of One or More of the Five Proposed Tract Blocks

To facilitate the decision to remove one or more lease areas from the sale, the following section is included to provide a summary of conditions within each of those lease areas. Removal of certain tracts or even entire lease areas has been proposed as a mitigative measure. The following subject outline has been included in this section.

Summary of Impacts in the Five Proposed Tract Blocks

a. Introduction
b. Santa Monica Bay
   i. Geologic Conditions
   ii. Weather Conditions
   iii. Petroleum Resources
   iv. Barging and Tankering Operations
   v. Water Quality
   vi. Air Quality
   vii. Recreation/Esthetics
   viii. Historic and Archaeologic Resources
   ix. Biological Resources
      a) Fisheries
      b) Marine Mammals and Birds
      c) Rare and Endangered Species
      d) Unique Habitats
      e) Benthic Communities
      f) Intertidal Communities
c. San Pedro
   Same 9 headings
d. Santa Barbara - Catalina
   Same 9 headings
e. Santa Rosa - Cortes North
   Same 9 headings
f. Santa Rosa - Cortes South
   Same 9 headings

a. Introduction

The 297 tracts proposed for leasing are divided into five areas: Santa Monica Bay, San Pedro Bay, Santa Barbara-Catalina, Santa Rosa-Cortes North, and Santa Rosa-Cortes South. The Santa Monica tracts are all contiguous and stretch from near Mugu Lagoon in the north to southwest of Point Vincente. There are 36 tracts covering 163,000 acres. The 56 San Pedro tracts (280,000 acres) are also all contiguous and begin northwest of Point Fermin and stretch south, paralleling the coast, to Dana Point. The 34 contiguous tracts (100,400 acres) stretching from west and north of Santa Barbara Island to northwest of Catalina Island are referred to as the Santa Barbara-Catalina tracts. The Santa Rosa-Cortes North tracts begin southwest of San Miguel Island and stretch eastward past the southern side of Santa Rosa Island to near the midpoint of Santa Cruz Island. There are 60 tracts containing 291,000 acres. Santa Rosa-Cortes South contains the greatest number of tracts, 111 (639,400 acres). The largest group, 83, of contiguous tracts is located along the Santa Rosa-Cortes Ridge and covers the Tanner and Cortes Banks. Seven tracts lie to the southwest over the Northeast Bank. Twenty one tracts are located on a ridge west of the Tanner Basin. Graphic 1 illustrates these tracts.

Since potential impacts vary considerably from area to area, each of these five major areas is analyzed separately. Table VIII-1 illustrates the economic and resource data for each lease area. This is followed by a summary of conditions in each of the five areas and/or the effects OCS development would have in each area, with respect to 1) geologic conditions, 2) weather conditions,

PROPOSED LEASING AREAS IN SOUTHERN CALIFORNIA BORDERLAND

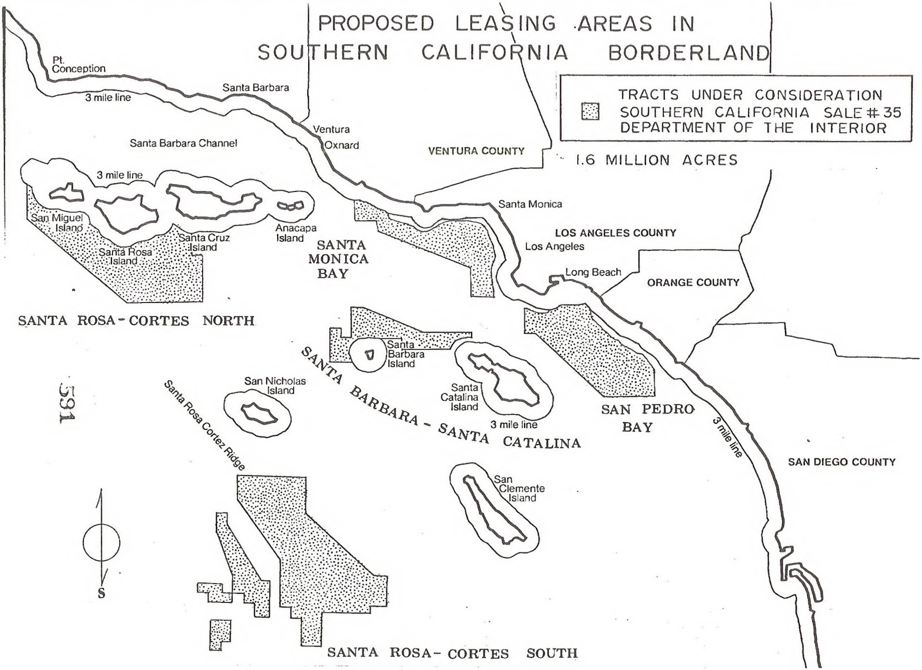

Table VIII-1

Estimated Economic and Resource Data by Area*

Economic and Resource Data	San Pedro	Santa Monica	Cortes North	Santa Rosa Cortes South	Santa Barbara-Catalina
Million Barrels of Oil	709-6,259	329-2,904	242-2,136	239-2,110	67-591
Billion Cubic Feet of Gas	602-7,023	479-5,588	603-7,035	613-7,152	103-1,202
Acreage Estimated	280,000	163,000	291,000	639,400	180,400
Platforms	4-18	3-9	2-10	3-16	2-7
Wells	266-1691	138-873	146-927	241-1527	69-437
Miles of Pipeline	20-122	20-122	38-225	45-270	37-225
* Annual Oil by Pipeline (MM BBL)	(17.7-63.8) 17.7-156.5	(7.2-53.2) 8.2-72.6	(5.9-90.2) 6.1-53.4	(0.8-17.5) 0-0	(0.0) 0-0
Annual Oil by Tanker (MM BBL)	0-0	(1-7.6) 0-0	(0.1-1.8) 0-0	(5.1-107.7) 6.0-53.0	(1.7-?) 1.68-14.8
Drill Cuttings in 1000 Tons	151-957	78-494	83-525	136-864	39-247
Drilling Mud Discharged in 1000 bbls	60-367	32-189	32-201	53-331	17-99
Mud Additives Discharged in 1000 Tons	4.2-25.9	2.3-13.3	2.3-14.2	3.7-23.3	1.2-7.0
Volume of Produced Brine (MM BBL)	709-6,259	329-2,904	242-2,136	239-2,110	67-591

* Figure derived by apportioning high estimate according to USGS percentage. Figure in parenthesis apportioned as explained in Section III.A.2.

Table VIII-2 gives a breakdown of spillage emanating from each tract block for oil and gas production and transportation activities. It is of some value in indicating the magnitudes and rates of spillage. Variability in spillage rates between areas is caused by the varying mixtures of transportation utilized. Distance from source of production to its landing is not entered as a factor. Obviously, length of route would be a factor in pipelines and potentially so for tankers. Consideration of factors such as depth of tracts, topographic relief, geologic hazards, oceanographic and climatic conditions and vessel traffic would greatly add to the sophistication and usefulness of the table but data is either unavailable or not readily available for analysis in regard to them. Oil will generally be spilled within the blocks themselves, but some may be spilled at remote locations by tanker casualties or pipeline breaks. Terminal operations will also result in persistent small spills and infrequent larger ones. Table VIII-2 shows two totals, one based upon treatment of tanker ballast and wash water, and the other is based upon no treatment. Table VIII-3 summarizes loss rates (ppm) for the areas.

Table VIII-2 Oil Spillage (Bbl) by Source for the Five Major Tract Blocks Over the Life of Production

		SP	SM	SR-CN	SR-CS	SB-CAT
Platform Fires						
	Low	7090	3290	2420	2390	670
	High	25,500	24,300	36,800	50,100	-
Well Blowouts						
	Low	31,905	14,805	10,890	10,755	3015
	High	114,750	109,350	165,600	225,450	-
Overflow, Malfunction or Rupture	Low	2907	1349	992	980	275
	High	10,455	9,963	15,088	20,541	-
Ship Collision						
	Low	638	296	218	215	60
	High	2,295	2,187	3,312	4,509	-
Minor Spills						
	Low	2,127	987	726	717	201
	High	7,650	7,290	11,040	15,030	-
Pipelines						
	Low	10,635	4,320	3,555	495	⊖
	High	38,250	36,450	53,340	10,515	⊖
Tanker/Barge (treated wash)	Low	0	13,951	1,682	69,313	22,521
	High	0	103,408	24,869	1,447,104	-
TOTALS FOR TREATED						
	Low	55,302	38,998	20,483	84,865	26,742
	Rate	0.000078	0.000122	0.000085	0.000355	0.000399
	High	198,900	292,948	310,049	1,773,249	
	Rate	0.000078	0.000121	0.000084	0.000354	
Tanker/Barge (untreated wash)						
	Low	0	164,649	20,060	826,477	268,783
	High	0	1,220,775	296,860	17,285,049	
TOTALS FOR UNTREATED						
	Low	55,306	189,696	38,861	842,029	273,004
	Rate	0.000078	0.000577	0.000161	0.003523	0.004075
	High	198,900	1,410,315	582,040	17,616,194	
	Rate	0.000078	0.000580	0.000158	0.003515	

* Spillage from these sources will occur anywhere from the production site to the land destination.

Table VIII-3 Oil Loss Rates By Tract Blocks (ppm)

	Wash Treated		Wash Untreated	
	Low	High	Low	High
SP	78	78	78	78
SM	122	121	577	580
SR-CN	85	84	161	158
SR-CS	355	354	3523	3515
SB-CAT	399	-	4075	--

3) petroleum resources, 4) water and 5) air quality, 6) recreational/ esthetic resources, 7) historical and archaeological resources, and 8) biological resources.

b. Santa Monica Bay

i. Geologic Conditions

There is high potential for slumping due to existing geological structures in the northern and southern tracts. The tracts in the northwestern sector seem to be very active tectonic areas, which may present seismic hazards. Active faults are found throughout the area and many were the sites of earthquake epicenters (3.0-3.9 magnitude). Thorough site surveys must be conducted prior to placing platforms, pipelines and so on, to avoid these geological hazards.

ii. Weather Conditions

Annual average winds are generally from the northwest at 10-14 knots. There are three common severe wind patterns. 1) Northwesterly winds are the most important severe winds, generally 25 knots or more, and occur mostly during the spring. 2) Santa Ana winds (northeast winds) may reach speeds of 50 knots and continue to blow well out to sea. However, these winds are of no particular concern beyond 50 miles at sea. 3) Southeasterly winds are the least frequent of the severe winds. However, they are potentially damaging and may reach 50 knots or more. Wind waves and swells do not present serious problems to OCS development in Southern California.

The specific effects of winds in the Santa Monica tracts are as follows: Northwesterly winds would sweep a spill shoreward. Santa Ana winds would push it out to sea where it might reach part of northern Channel Islands. Southeasterly winds would drive a spill ashore in the bay area.

e. Santa Rosa - Cortes North

i. Geologic Conditions

Lease areas of questionable and/or potential slumping are located in the tracts south of the San Miguel Passage. Highly active fault areas and potential slumping locations are found along the western boundary of the lease tracts and the lease tracts located along the eastern flank of the Santa Cruz Basin contain similar hazards. Special consideration must be given to identifying these potential hazards prior to the placement of any structures.

ii. Weather Conditions

Annual average winds and severe northwesterly winds would blow an uncontained oil slick onto San Nicolas and possibly Santa Barbara Island. Santa Ana winds would drive a slick occurring in the northern tracts along or around Santa Rosa and San Miguel Islands. A slick in the southern tracts would probably be forced out to sea. Southeasterly winds would push the slick toward all four islands (San Miguel, Santa Rosa, Santa Cruz and Anacapa) and possibly ashore.

iii. Petroleum Resources

The Santa Rosa area is potentially the third most economically productive of the five areas with estimated hydrocarbon resources of 242-2,136 million barrels of oil and 603-7,035 cubic feet of gas. In order to fully develop the area it would require the construction of 2-10 platforms, 146-927 wells and 38-225 miles of pipeline.
(5.9-90.2)
The annual oil transported by pipeline is estimated from 6.1-53.4 million barrels and some test production via tanker. Drill cuttings of 83-525 thousand tons could be produced and 32-201 thousand tons of

iii. Petroleum Resources

The Santa Monica area is potentially the second most economically productive of the five areas with estimated hydrocarbons resources of 329-2,904 million barrels of oil and 479-5,581 cubic feet of gas. In order to fully develop the area it would require the construction of 3-9 platforms, 138-873 wells and 20-122 miles of pipeline. The annual oil transported by pipeline is estimated from (7.2-53.2) 82-72.6 million barrels. Test production would be shipped via tanker. Drill cuttings of 78-494 thousand tons would be produced and 32-189 thousand tons of commercial mud may be released to drill the estimated wells. Mud additives in the amount of 2.3-13.3 thousand tons, are estimated to be discharged into the water. The volume of brine produced in the drilling operation, assuming a 50 percent cut, is 329-2,904 million barrels.

iv. Barging and Tankering Operations

Barging and tankering will only be used to transport test production and some deepwater tract production. After the initial testing, pipeline will be constructed to transport the oil and gas to shore. The duration of test barging operations will be relatively short and should not represent any major risks. Other OCS activities in this, and the other lease areas, will be outside shipping lanes and will not interfere with waterborne commerce.

v. Water Quality

Due to the large pollutant inputs from industrial and municipal ocean discharges, the pollutant concentration in the sediment is high in many parts of this area.

Sediments around the Palos Verde area have an extremely high concentration of pesticides. Any resuspension of these sediments or polluted sediments from other locations within the Santa Monica Bay area would have deleterious effects(Section III.C.2) With existing poor water quality in some of the nearshore areas adjacent to these tracts, any additional stress may exceed the environment's ability to assimilate these pollutants.

vi. Air Quality

The proposed lease areas can be placed into three groups with regard to air quality. The groups are based on the relationship of the geographical area to the surrounding environment and that area's potential to affect air quality if it (the area) is developed.

In terms of the greatest negative onshore impact caused by the deterioration of the air quality, the Santa Monica Bay and San Pedro Bay proposed lease sites rank the highest. Since these two areas are close to shore and to the major onshore air basins, any offshore oil spill, fire, gas leak, or operating activities which would decrease the air quality would also affect the onshore areas. Since the lighter fractions of the oil volatilize rapidly, any spill would increase the level of reactive hydrocarbons in the onshore air in a short period of time. The dissipation rate would also be reduced because of the closeness of the two sites from shore. The same problems would relate to fires, gas leaks, and operating activities.

vii. Recreation/Esthetics

Impacts on recreation and esthetics will result from increased boat traffic, platforms, shore facilities and oil spills.

Oil spills will have more disruptive potential in these tracts than in the others. Most of the bay's shoreline is composed of sandy recreational beaches. Crowds of 750,000 persons are common during the summer. Prevailing winds and currents would tend to distribute the oil throughout the bay. In addition to decreasing the recreation values of the beach, oil would also foul boats. Oil soaked beaches and boats would create very adverse aesthetic impacts.

Ships and boats serving the offshore industry would create additional congestion offshore and in the harbors, already crowded with over 7600 private boats.

The platforms themselves and subsea completions would create navigational hazards and restricted anchorage areas. Platforms will also create esthetic impacts by creating visual disruptions to the smooth panorama of the sea and offshore islands.

Onshore impacts will occur when shore-side treatment, storage or transfer facilities are constructed, or beach crossings for pipelines are built. These facilities will have less impact where they can be placed in existing industrial zones so that they do not alter the character of the environment.

viii. Historic and Archeologic Resources

No serious threat to historic values, onshore or offshore, is anticipated.

ix. Biological Resources

a) Fisheries

The Santa Monica lease area is considerably more productive than any of the other areas (except San Pedro), for sport fishermen. An average of more than three million fish were caught during '71-'72, an average of over 83,000 fish per tract. Commercial operations (prohibited within the Bay itself) are also very productive, averaging 310 million pounds during '70, '71, '72, an average of 8.6 million pounds per tract. Most of the commercial catch consisted of wetfish. The high productivity is due partly to a large area of upwelling just north of the lease area. Another factor is that there is intense effort, both sport and commercial in this area. Offshore development could have numerous deleterious impacts upon the fisheries. Increased boat traffic to and from the platforms could interfere with sport and commercial fishermen. The platforms themselves would create significant obstacles to drifting seine fishermen and remove sections of sea floor from use (see Section III. E.). Subsurface structures could also become potential snags to fishing nets, particularly trawls. Some trawling occurs north of Point Dume. Sport fishermen, on the other hand, might find that the attraction of large numbers of fish to platforms could make it easier to locate productive areas. Low levels of oil pollution or major spills could both result in large scale losses to fisheries due to destruction of juveniles, decreased resistance to disease, tainting of flesh, and so on (see Section III.E.). Another potentially deleterious impact could result from the resuspension of toxic outfall materials in the sediments during OCS operations.

b) Marine Mammals and Birds

This is a relatively unimportant area for marine birds and mammals except for the upwelling area near Point Dume, which may serve as an important nearshore feeding area. However, there are a number of shoreline and coastal bird species which occupy this area (Appendix X .E.5.) including three endangered species, the California least tern, Belding's savannah sparrow, Light-footed clapper rail, and one rare species, California-black rail. In addition, coastal mammals such as the harbor porpoise and bottlenose porpoise occur. Therefore, a major oil spill could affect these species by destroying their critical habitat (see Section III.D.7.) or food supplies. This area would be most susceptible to onshore facility construction which could result in destruction of critical nesting or feeding habitat.

c) Rare and Endangered Species

In addition to the rare and endangered birds listed above, there are seven species of endangered cetaceans found in all the lease areas. They are: gray whale (*Eschrichtius gibbosus*), blue whale (*Balaenoptera musculus*), finback whale (*B. physalus*), sei whale (*B. borealis*), humpback whale (*Megaptera novaeangliae*), Pacific right whale (*Balaena glacialis*) and the sperm whale (*Physeter catodon*).

d) Unique Habitats

There is one Area(s) of Special Biological Significance (ASBS) adjacent to the Santa Monica lease blocks. It stretches from Mugu Lagoon to Latigo Point. It should be stressed that Mugu Lagoon is one of the most valuable estuarine areas in Southern California. The relatively undisturbed conditions within the lagoon make it extremely important to safeguard this resource. Any onshore facilities or pipelines in this area could be very disruptive. Estuaries are particularly vulnerable to oil pollution and a boom or bubble curtain should be immediately available at the entrance of the lagoon to protect it in case of a spill offshore.

e) Benthic Communities

The benthos of Santa Monica Bay was studied to the 100 meter contour over fifteen years ago. More recently, restricted areas, near sewage outfalls have been examined. Based upon the four dominant species of an area, there were three benthic assemblages. Two of these (*Amphoidia* and *Chloeia-Pectinaria*) were reported within the proposed lease area. Other parts of Santa Monica Bay and the area from Mugu Lagoon and Point Dume past the 100 m contour are less well known. Certain areas within Santa Monica Bay have been subject to domestic and industrial pollution effluents for years. This has caused the benthic communities to become greatly altered near the outfalls. Other parts of the area may have also become altered within the last fifteen years or longer, but this is not known. The area from Point Mugu to Point Dume is subject to less pollution and human alteration than Santa Monica Bay, so the benthos would be less likely to be altered.

Kelp beds are present off the northern coast of Santa Monica Bay and along the coast to the west of Point Dume. These beds are not as extensive as those to the northwest from Santa Barbara to Point Conception, but, now that the former beds of the Palos Verdes Peninsula have become greatly reduced, are the only extensive kelp beds between Newport Bay and Ventura. There is good evidence that petroleum does not harm kelp because of a "protective" mucus layer, but little is known about the effect on the over 625 invertebrate species, 57 fish species or the 128 macrophytic species reported associated with the kelp habitat

(Section II.F.2.). The beds of this area become even more important when one considers their importance as a population center necessary for the propagation and continuous distribution of certain species between a distance of over 100 miles of mainland coast. Some species will have brood stock populations on the offshore islands located between Newport Bay and Ventura. These kelp beds on the island shelves will act as a safety valve for species propagation, but will not negate the importance of the Santa Monica Bay area kelp beds as brood stock centers for kelp beds.

The potential for disruption of benthic assemblages in the Santa Monica Bay area is one of the least of any of the proposed sale areas. Although there is evidence of high species diversity in certain areas, there has been significant human alteration of much of the area and many of the pollution sensitive species may have already been eliminated. A possible exception to this generalization is the area between Point Mugu and Point Dume which has been far less altered than other areas in Santa Monica Bay.

Another impact possible in Santa Monica Bay is the resuspension of polluted sediments resulting from laying pipelines or drilling operations near sewage outfalls.

f) Intertidal Communities

The evidence indicates the biological damage to a rocky shore intertidal community is far more severe than it is on a sandy beach. We will regard this assumption to be correct in every area to be considered in the following summary and consider only the impact on rocky shore areas.

The vast majority of the coast of the proposed Santa Monica Bay lease area is sandy beach, although there are numerous small rocky outcrops scattered along the beach. Much of the Palos Verdes Peninsula coast is rocky shore, but it has been considerably altered by human activity. The same could be generalized from the "relatively" unaltered shoreline from Point Mugu to Point Dume, where beach goers have reduced much of the larger, bizzare and beautiful species through collecting. This, together with generally calmer summer westerly winds indicates this area would experience far fewer biological impacts than the offshore island areas.

c. San Pedro

i. Geologic Conditions

Tracts in the northwestern part of the lease area (San Pedro Valley area) are sites of known slumping. Other possible areas of slumping are the central lease area, offshore from Huntington Beach, and the south central lease area between Newport Canyon and Lausen Knoll. Active faults are scattered throughout this lease area with linear epicenter trends noticeable along the northeast and southwest borders. High magnitude earthquakes have occurred along the northeast border (Newport-Inglewood fault area).

ii. Weather Conditions

Northwesterly and southeasterly winds would push a slick toward shore in southern Los Angeles County and Orange County. Santa Ana winds would blow a slick towards Santa Catalina Island.

iii. Petroleum Resources

The San Pedro area is potentially the most economically productive of the five areas with estimated hydrocarbon resources of 709-6,259 million barrels of oil and 602-7,023 billion cubic feet of gas. In order to fully develop the area it would require the construction of 4-18 platforms, 266-1691 wells and 20-122 miles of pipeline. The annual oil transported by pipeline is estimated from (17.7-63.8) 17.7-156.5 million barrels and some test production oil via tanker. Drill cuttings of 151-197 thousand tons would be produced and 60-367 thousand tons of commercial mud may be discharged to drill the estimated wells. Mud additivies in the amount of 4.2-25.9 thousand tons, are estimated to be discharged into the water. The volume of brine produced in the drilling operation, assuming a 50 percent cut, is 709-6,259 million barrels.

iv. Barging and Tankering Operations

Like Santa Monica, the San Pedro lease area will probably only experience barging and tankering operations for a short period when test production is being taken ashore. Because of the short duration of these operations they are not considered to represent a significant impact.

v. Water Quality

This area has the same potential for impacts that the Santa Monica Bay area has. The Los Angeles and Long Beach harbors have been two areas of extremely low water quality. Although these areas have had an increase in the water quality in the past years, additional pollution from OCS operations may have very deleterious effects.

vi. Air Quality

The San Pedro Santa Monica tracts are treated together. Refer to the air quality discussion for Santa Monica.

vii. Recreation/Esthetics

Impacts on recreation and esthetics will result from increased boat traffic, platforms, shore facilities and oil spills. The area adjacent to the lease tracts is, like the Santa Monica Bay area, highly urbanized. The Long Beach San Pedro portion of these tracts is more highly industrialized than Santa Monica. In spite of the industrialization on this northern portion of the tract area, there are miles of valuable recreational beaches. Newport Beach alone often has 100,000 visitors per day during the summer.

An oil spill would very adversely effect recreation by contaminating the beaches, boats and marinas. If beaches remained contaminated for long periods, many local tourist oriented businesses would experience severe problems. Prevailing currents would probably carry oil south of the greatest number of boats berthed in San Pedro and Long Beach. However, thousands of other boats are moored in Newport Beach, Balboa, etc. and could be contaminated.

An increase in ship and boat traffic to service the offshore industry would create additional congestion and traffic in and out of the harbors.

Platforms will create navigational hazards. They will also be disruptive esthetically. Less visual impact will occur in areas like Huntington Beach, where offshore petroleum production from state lands is already taking place. However, further south thousands of homes face the lease area, and the view from these houses is one of their primary assets. Platform construction, for esthetic reasons alone, is strongly opposed by many residents.

San Pedro, Long Beach and Huntington Beach are already highly industrialized and additional facilites would have relatively little impact. However, development in the remaining residential, recreational and agricultural areas would have very adverse effects.

viii. Historic and Archeological Resources

No direct impacts on historic or archeological values is anticipated. There are a number of historical landmarks that would be indirectly impacted in that OCS development would change the character of their surroundings. Numerous valuable archeological sites have been discovered. It is possible that additional sites would be discovered during development activities.

ix. Biological Resources

a) Fisheries

This is the most productive area for sport and commercial fishermen, based on total catch. Sportsmen landed an average of over 3,063,000 fish during 1971, 72. This is slightly higher than the total for Santa Monica, although the average per tract is considerably less, 54,698 versus 83,333 fish. Commercial fishermen landed over 465 million pounds (average) during 1970, 71, 72. The average per tract was slightly lower than that for the Santa Monica tracts, 8.3 million versus 8.6 million. Like Santa Monica, fishing pressure here is intense and most of the commercial catch consists of wetfish. The deleterious effects of offshore development here are nearly identical to those in Santa Monica (see b.ix.a. for details).

b) Marine Mammals and Birds

This lease area is similar to Santa Monica Bay in being of relatively minor importance to marine birds and mammals. There are, however, a number of nesting sites (Section III.D.7.) of such endangered species as the California Least Tern and Light-footed Clapper rail, and as in Santa Monica Bay, they could be seriously impacted by oil spills or onshore construction which could destroy the critical habitat of these species.

c) Rare and Endangered Species

The same endangered species found in the Santa Monica area occur here.

d) Unique Habitats

Three ASBS and eight refuges (including one of the ASBS) are located opposite the San Pedro tracts. Two reserves (one an ASBS) and one refuge (an ASBS) are located south of the tracts and would probably be impacted by a large spill. Prevailing currents would move the oil toward them.

e) Benthic Communities

Like Santa Monica Bay, the benthos of the proposed San Pedro Bay lease area was studied to the 100 meter contour over fifteen years ago. Based upon the four dominant species of an area, there were five benthic assemblages. Four of these communities (*Amphiodia*, *Choeia-Pectinaria*, *Nothria-Tellina* and *Amphioplus*) were reported within the proposed lease area. Other areas of the San Pedro Bay area are less well known. Most of the coastal areas of this area have been subject to domestic and industrial pollution effluents for years. This has caused the benthic communities to become greatly altered near the outfalls. Other parts of the area may have also become altered within the last fifteen years or longer, but this is not known. The coastal area south of Newport Beach is slightly less altered and receives a reduced pollution load, so the benthos would be less likely to be altered.

Kelp beds are sparsely scattered between Newport Bay and Dana Point, the southern end of the proposed lease area. There are no extensive kelp beds south of Dana Point until one reaches San Diego. This puts an added importance on maintaining a potential brood stock of kelp bed associates because of the long mainland coastal distance (Newport Bay and northern Santa Monica Bay) between large kelp bed areas. For further discussion, see Santa Monica area in this section.

The potential for disruption of benthic assemblages in the San Pedro Bay area may be the least of any of the proposed sale areas. Although there is evidence that there is high species diversity in certain areas, there has been significant human alteration of much of the area and many of the pollution sensitive species may have already been precluded from much of the area.

Another possible impact in the San Pedro area is the resuspension of polluted sediments resulting from laying pipelines near sewage outfalls.

f) Intertidal Communities

Most of the shoreline facing the San Pedro lease area is sandy beach or harbor. The rocky portions have been altered considerably by human activity, although they retain significant value biologically. The severity of damage to this lease area would probably be approximately the same as for the Santa Monica shoreline.

d. Santa Barbara - Catalina

i. Geologic Conditions

Areas along and/or within steep gradient slopes may be potential areas of slumping. This lease area is centrally located at the intersection of two major faults and is an area of complex and active faulting.

ii. Weather Conditions

Northwest winds would push oil directly ashore on Santa Barbara if a spill occurred in tracts to the west of Santa Barbara. Oil in tracts to the north and east of Santa Barbara would impact Santa Catalina and onshore Southern California.

Santa Ana winds would produce impacts on Santa Barbara and San Nicolas Islands. Southeasterly winds would result in impacts on coastal areas.

iii. Petroleum Resources

The Santa Barbara-Catalina area is potentially the least productive of the five areas with estimated bydrocarbon resources of 67-591 million barrels of oil and 103-1,202 billion cubic feet of gas and an area of 180,400 acres. In order to fully develop the area it would require the construction of 2-7 platforms, 69-437 wells and 37-225 miles of pipeline. The annual amount of oil transported by tanker is estimated from 1.68-14.8 million barrels. Pipeline transport is not expected due to water depths. Drill cuttings of 39-247 thousand tons would be produced and 17-99 thousand tons of commercial may be released to drill the estimated wells. Mud additivies in the amount of 1.2 to 7.0 thousand tons, are estimated to be discharged into the sea. The volume of brine produced in the drilling operation, assuming a 50 percent cut, is 67-591 million barrels.

iv. Barging and Tankering Operations

Barging and tankering will be used to transport not only test, but production oil and gas, as well. Existing technology is not capable of laying pipelines in the water depths encountered between this lease area and shore. Barging and tankering operations naturally require more transfer steps than pipelining. Small spills will almost invariably occur during these transfer operations and the possibility of large spills resulting from collisions is greatly increased. A large spill in this lease area would have devastating effects. Refer to the following sections. The use of barges and tankers will also create considerable congestion in the ports receiving the petroleum and possible navigational problems in the shipping lanes.

v. Water Quality

The immediate area of the tracts would suffer significant short term water quality degradation from any type of pollutant discharge. However, the currents in the area should preclude any long term effect. Due to the low amount of particulate matter, relative to the mainland tracts, a low percentage of an oil mass from a spill will sink to the ocean floor, unless the oil mass is transported to a nearby island or mainland coast. Catalina and Santa Barbara Islands, which have relatively pristine waters, could be significantly affected by discrete oil patches detached from oil spills or seeps in the Santa Catalina-Santa Barbara tracts.

vi. Air Quality

The Santa Barbara-Catalina site presents the same problems as the Santa Monica Bay and San Pedro Bay sites, but to a lesser degree because of the distance from shore. Because of the air currents, disruptions over the site would not pose an air quality problem on Santa Catalina Island. The distance from the mainland would allow emissions to dissipate considerably before reaching the coastline and the air basins. However, the distance is not so great that onshore impacts will be eliminated. Any major disruption at the site would have a negative impact onshore.

vii. Recreation/Esthetics

Large numbers of people enjoy recreational sailing, fishing, diving and camping on and around the islands (Santa Barbara and the north end of Catalina) at each end of the lease block (Section III.I.1.) Catalina Island is undeveloped at the north end and appears much as it did prior to European arrival. Santa Barbara Island is part of the Channel Islands National Monument established in 1938 to provide sanctuary to numerous sea bird rookeries, marine mammals and sea life. Much of the value of this area lies in its unpolluted ocean environment. If platforms are permitted on these tracts, their presence will alter the appearance of both Santa Barbara's and Santa Catalina's setting to some degree, depending upon the intensity of development. This would change the character of the recreation experience.

Spills would depreciate the recreation quality significantly because much of the monument's value lies in its biological resources primarily within the intertidal and subtidal zones.

Although these tracts are visible from the mainland on clear days, structures or facilities will not be discernible with enough size or clarity to constitute a significant visual alteration. Therefore, large numbers of viewers on the mainland coast will not be affected; however, surface facilities will affect thousands of boaters who annually make use of the waters around Santa Catalina and Santa Barbara Islands.

viii. Historic and Archeological Resources

No forseeable historic values will be affected other than the change in "character".

Archeologic values are widespread on the Channel Islands and much less altered there than on the mainland. Any onshore activity could impact archeological values. No onshore facilities are possible at Santa Barbara Island, but the possibility exists for Santa Catalina Island.

ix. Biological Resources

a) Fisheries

The Santa Barbara-Catalina area ranks fourth for sport fisheries, both in total catch (467,200 fish) and average catch per tract (13,741). Although this lease area may not be as productive as the Santa Monica and San Pedro lease areas the difference is certainly not as large as the figures would indicate. Fishing pressure in this area is only a fraction of that in the near shore tracts. Commercial fishermen landed an average of 41,900,000 pounds during 70, 71 and 72, 1,232,352 pounds per tract. This is roughly 1/7th the average per tract for Santa Monica and San Pedro. A significant proportion of this difference is the result of less fishing pressure. For the impacts of OCS development on fisheries, refer to b.ix.a. under

Santa Monica. The only major difference is that there is no trawling in this lease block. There would be, therefore, less of a problem with nets snagging underwater obstructions and equipment.

b) Marine Mammals and Birds

This lease area could have a significant impact on what may be the largest population of Xantus murrelets along the California coast, and since these birds take their young to sea to feed after just a few days of age they would be very susceptible to an oil spill. Santa Barbara Island ranks fourth in pinniped populations for the OCS area. Considerable numbers of seals and sea lions could be exposed to relatively toxic oil spills due to the close proximity of several lease blocks west and northwest of the island.

c) Rare and Endangered Species

The endangered and rare species in the area are all cetaceans. Please refer to b.ix.c. under Santa Monica for details.

d) Unique Habitats

This lease area nearly surrounds Santa Barbara Island whose rich biological communities have earned it the designation of an ASBS. A short distance east of the tract are four other ASBS on or adjacent to Catalina Island. An oil spill in this area could have extremely deleterious effects on the marine life. Any pipelines or onshore facilities could, likewise, produce major impacts.

e) Benthic Communities

The benthos of the Santa Barbara-Catalina area is not well known. Since benthic organisms are largely distributed according to sediment type, an examination of the sediment distribution (Graphic 13) should give a rough idea of the composition of benthic organisms. The majority of the area apparently has a very fine silt-clay (mud) bottom. These bottoms grade into various sand composition bottoms. This indicates there probably are several different benthic assemblages. Most of the benthic organisms on the mud bottoms are detritus feeders. This is entirely different than the other proposed sale areas which should have a preponderance of filter feeding organisms.

Kelp beds nearly encircle Santa Barbara Island and are fairly well developed along the southwestern shore of Santa Catalina Island.

Although human alteration is more pronounced here than in Santa Rosa-Cortes North and South, conditions remain relatively pristine. The contaminants that are present come primarily from Avalon and rock quarrying on Santa Catalina Island, from the Los Angeles megalopolis, and boat traffic. Much of this pollution is diluted, to or nearly to, the lower limit of detectability.

f) Intertidal Communities

Nearly all the coast facing the proposed lease area is rocky shore (Graphic 10). These coasts are relatively undisturbed by most forms of human activity, although a limited amount of collecting of some of the larger, bizzare and more beautiful species by recreationists probably has reduced the community somewhat. This lease area's intertidal community would suffer severely from an oil spill.

commercial mud may be released to drill the estimated wells. Mud additives in the amount of 2.3-14.2, thousand tons, are estimated to be discharged into the water. The volume of brine produced in the drilling operation, assuming a 50 percent cut, is 242-2,136 million barrels.

iv. Barging and Tankering Operations

Barging and tankering operations of test production will probably occur from all the lease areas. After the initial test is transported, pipelines will be constructed to transport the oil and gas to shore. No major risks are seen in shipping the initial test production to shore.

v. Water Quality

Pollution from drilling operations or an oil spill could significantly degrade water quality. A pollutant in this area would tend to remain in the area because of current patterns. The presence of pollutants here would be a serious threat to the large numbers of marine mammals and birds.

vi. Air Quality

The Santa Rosa-Cortes North and the Santa Rosa-South sites would be the less objectionable from an air quality position. The South site is even somewhat more desirable than the North site since it is more distant from the onshore air basins. Any major disruption at the North site would increase the amounts of pollutants over Ventura and Los Angeles Counties. Any emissions from the South site would generally be dissipated before reaching San Diego County or Baja California, and pose the least threat of all the sites.

vii. Recreation/Esthetics

Nearly all recreation within or near these tracts consists of boating. San Miguel Island contains major pinniped rookeries and the loss of pinniped or bird rookeries through disturbance could adversely affect a portion of the recreational experience. Development of onshore facilities would pose greater disruptive potential for recreation as boating and diving take place mostly in the nearshore waters where jetties, docks, loading terminals and other such paraphernalia would reduce the attractiveness of, if not outright preclude, recreation in the vicinity.

Oil spills would have an obvious effect, reducing the attractiveness of both diving and boating. Numbers of people affected would be a fraction of the exposure at the mainland (see Section II.G.3.), but the total impact on the biota would be greater because the area is relatively pristine. The potential effects would be greater if these islands actually become a national park, due to increased access and visitor use.

viii. Historic and Archaeologic Resources

Flourishing Indian populations existed on the northern Channel Islands up to 40,000 years ago. The archeological remains of these early people in a nearly undisturbed condition. Any onshore facilities or facilities in shallow water around the islands (previously above sea level) could alter or destroy these potentially valuable archeological sites.

ix. Biological Resources

a) Fisheries

This area ranks third for sport fish landings, averaging 1,810,000 fish per year during 71, 72, or 30,166 per tract. Relatively little sport fishing effort is expended here. Catch per unit effort figures are not available, but they would probably show this area to have rich fisheries resources. The largest upwelling area within any of the lease tracts is located west of San Miguel Island. Zooplankton production is also the highest of any of the project areas. Ranges of 256 to 1024 cc/1000 m^3 were obtained by CALCOFI. The lower value in this range is four times the high value for any of the other areas. Although these figures only represent average values they still indicate that the area is very productive. The relatively low sport fish and commercial landings (commercial landings here were lower than for any of the other areas, an average of 15,600,000 pounds during 70, 71 and 72, 260,000 pounds per tract) are due in large part to lack of effort instead of a lack of fish.

b) Marine Mammals and Birds

This lease area borders upon the largest marine mammal and sea bird populations of the Southern California OCS area. Because of the close proximity of these tracts to San Miguel Island, development could produce greater impacts on these animals than those of the other lease blocks (see Sections III.C.3. and III.D.3. and 4.).

c) Rare and Endangered Species

In addition to the seven endangered whales another endangered species is found here, the brown pelican (*Pelecanus occidentalis californicus*). Two rare species, the Guadalupe Fur Seal (*Arctocephalus philippii townsendi*) and the Island Fox (*Urocyon lattorallis*) are also found in this area.

d) Unique Habitats

Twenty one tracts are located immediately opposite San Miguel, Santa Rosa and Santa Cruz Islands. Anacapa Island is somewhat east of the tracts but well within the range of potentially devastating impacts in the event of a large spill. The waters surrounding these islands are classified as ASBS to a distance of one mile or the 300 foot depth contour whichever is greater. Biologically, these islands and their surrounding waters represent by far the most important area within Southern California. Water quality around the islands is excellent and there is less human activity than in any of the other lease blocks except Santa Rosa-Cortes South. These islands are critically important to marine mammals and birds. An oil spill here would have more severe impacts than on any other tract.

e) Benthic Communities

Little information exists on the benthos of this area. However, benthic organisms are largely distributed according to sediment type and the sediments have been reasonably well studied. The bottom is primarily of fine to medium sand (sandy silt and silty sand) with at least three significant areas of coarser sand and a small area of silt (Graphic 13). This, coupled with the fact that the northern islands are within a water temperature and biological transitional zone, would indicate that there should be several distinct and productive benthic assemblages. The extremely productive upwelling of the area, particularly to the west of San Miguel Island, could also be a factor influencing community composition and productivity.

Kelp beds cover a significant portion of the island shelves and are present off nearly the entire coast of Santa Rosa Island.

Another important factor is the relatively unaltered condition of the area. Although evidence for benthic community disruption in oceanic areas from oil spills is small, the potential for some disruption in this area is high compared with other proposed lease areas. The presumed high diversity of benthic species, plus the fact that many have not been subjected to extensive human alteration, means there is a high probability that some of the species will be very sensitive to oil pollution. Some of the species may be 1° endemics (see Section III.C. 2 that could become extinct if they were sensitive to oil.

f) Intertidal Communities

Nearly all the coast facing the proposed lease area is rocky shore (Graphic 10). Most of this area is relatively undisturbed by human activity. This, coupled with a strong summer westerly wind component, would indicate this area as potentially having the most severe impact from a major oil spill.

The area is also within a water temperature and biological transitional zone which would suggest several unique species and/or biological assemblages.

Although evidence for recovery of an oiled intertidal community within five or six years is strong, some of the species may be 1°

endemics which could become extinct. Conversely, on the upper intertidal, where most of the biological damage would occur, species tend to be hardy eurytopics and would not suffer complete population destruction.

f. Santa Rosa - Cortes South

i. Geologic Conditions

Slumping is evident along the eastern side of Tanner Banks and Tanner Canyon and is questionable along the boundaries of the steep slope gradients of the lease areas. Liquefaction may be found within and along the Tanner Basin area (Santa Rosa-Cortes South). New findings have indicated that past faulting activity in this area has been extensive, although the age and recency of the activity is unknown at present.

ii. Weather Conditions

Northwest winds will push slicks away from the island and the coast. Santa Ana winds will drive the slick further out to sea, while southeast winds will force the slick upward toward San Nicolas and Santa Barbara.

iii. Petroleum Resources

The Tanner-Cortes area is potentially the fourth most productive of the five areas with estimated hydrocarbon resources of 239-2,110 million barrels of oil and 613-7,152 billion cubic feet of gas and an area of 639,400 acres. Water depths in most of this lease area exceed 250 meters. As a result, industry had projected only subsea completions; however, platforms are now expected to be used in depths of 850 feet or even 2,000 feet due to technological advances in platform design. Full development of the area would require the construction of 3-16 platforms, 241-1527 wells and 45-270 miles of pipeline. The oil transported from this area is expected to

(5.1-107.7)
be entirely by tanker at an annual rate of 6-53 million barrels. Industry has projected a possible pipeline north through the Channel Islands and east to the coast. At the moment, however, pipeline laying barges are only capable of laying pipe in 1400 feet of water. The proposed pipeline route would encounter depths of over 1600 feet.

Drill cuttings of 136-864 thousand tons would be produced and 53-331 thousand tons of commercial mud may be released to drill the estimated wells. Mud additives in the amount of 3.7-23.3 thousand tons, are estimated to be discharged into the water. The volume of brine produced in the drilling operation, assuming a 50 percent cut, is 239-2,110 million barrels.

iv. Barging and Tankering Operations

Water depths between these tracts and shore will make it necessary, with existing technology, to ship all oil and gas produced. Pipelines are marginally feasible. As stated above, annual
(5 and 108)
production would range between 6 and 53 million barrels. This is over three and a half times the estimated reserves in the Santa Barbara-Catalina lease area, where shipping will also be necessary. Shipping risks from the Santa Rosa-Cortes South lease area will be much greater than from other areas. Large waves occur regularly, large quantities of petroleum will be shipped, and considerable distances will be covered. The possibility of small spills occurring during transfer operations in rough seas is very great. The number and distance of shipments will increase the possibility of ship collisions. See Section III.A.2. for a discussion of tankering. For the impacts of oil spills in this area, see the following sections.

v. Water Quality

Due to the circulation in these tracts any pollutant effect from an oil spill or drilling activities should be short term. Pollutants from OCS activities in these tracts might impact Mexican waters and coastal areas in northern Baja California.

vi. Air Quality

Air quality impacts for this tract are covered under air quality impacts on the Santa Rosa-Cortes North tract area.

vii. Recreation/Esthetics

Recreational use of these tract blocks is relatively light. Charter SCUBA boats and sport fishing boats occasionally utilize the Tanner and Cortes banks. Sport fishermen primarily hunt for tuna. The closest high use area for diving and fishing is San Clemente Island. Oil spills could reach the shores of San Clemente Island, although wind and current conditions generally do not move water in that direction. Tar balls from spills in the area could reach the mainland shore from mid-Baja California, north. Onshore facilities could adversely affect marine mammals and birds. In total, recreation would be affected least in this tract group, of the five groups.

These tracts are situated in an isolated open ocean environment, viewed from nearly uninhabited islands. Disruption of solitude would be the major esthetic impact.

viii. Historic and Archeological Values

Historic values could exist only as shipwrecks. Archeologic values are possible, but would probably be very limited.

The area was emergent during the time Indians occupied the Channel Islands, but only small portions. Potential impact on these values is much less than in the other lease areas.

ix. Biological Resources

a) Fisheries

This lease area is approximately 100 miles from the closest mainland port. Consequently there is not nearly as much fishing pressure from sportsmen. This is the least productive sport fish lease area. None of the tracts averaged over 900 fish during 70, 71. The area ranks third for commercial fishermen. During 70, 71, 72 an average of 267,205,000 pounds were landed, 2,407,000 pounds per tract. It is important to note that in this area the catch is predominately tunas, including blue fin and albacore, as opposed to the predominately wetfish landings from nearshore tracts. In 1975 wetfish are expected to bring $32.25/ton. Bluefin, however, will sell for approximately $480/ton and albacore from $560 to $760/ton. It is apparent that, although not as many fish are landed as from the nearshore areas, their value can be more than twenty times as great, per ton. OCS development in this area would have the same general effects as those discussed previously. Some important possible exceptions are: 1) tunas are migratory fish and are therefore not found within the lease area for much of the year; this fact should reduce their chances of being exposed, harmed or contaminated in the case of an oil spill; on the other hand, if the spill occurred during tuna season the effects would be more severe; 2) tuna seiners use much larger nets than wetfish seiners and drift for longer periods; the obstruction of platforms would, therefore, present a more serious problem than for nearshore wetfish fishermen.

b) Marine Mammals and Birds

The absence of any nearby islands or coastal areas with associated biota reduces the impact upon these tracts to the minimum. However, scattered reports indicate that this area of rich upwelling could be one of the most biologically productive areas of the Southern California OCS. This area, therefore, could be a very important feeding area for marine mammals, especially the cetaceans, and possibly for marine birds although rough seas would generally preclude surface feeding. The remoteness of this area would eliminate such disturbance problems as would exist near the islands (Section III.D.4.). However, the use of tankers and barges could result in a greater frequency of shipping accidents.

c) Rare and Endangered Species

The seven endangered whales discussed previously are also found within these lease blocks.

d) Unique Habitats

There are no designated reserves, refuges or ASBS within these tracts. However, there is considerable evidence that the Cortes Banks may indeed be one of the most unique areas in all of Southern California. Large communities of purple and red coral have been reported. These would make the Cortes Banks unique for the entire Southern California coast. Further investigations of this area have been initiated. See Section IV.E.4. for the proposed stipulation for the protection of biological resources.

e) Benthic Communities

Little is known about the benthos of Santa Rosa-Cortes South. This area contains the Tanner and Cortes Banks, known to be productive, but essentially unknown with respect to benthic assemblages. As mentioned previously, benthic organisms are largely distributed according to sediment type. The sediment of the area is primarily silty sand but also contains silt, at least two areas of coarse sand and some rocky sections. The shallow Bishop Rock and probably other areas of Cortes Bank are hard bottoms and support a highly productive epifaunal assemblage, possibly including the rare purple coral. There is considerable vertical relief with ranges from approximately 0 meters (Bishop Rock) to about 750 meters. These facts indicate there should be several distinct and productive benthic assemblages within the area. There are apparently no kelp beds in the area.

Another factor which may be as important as the high productivity and diversity of the benthos is the unaltered condition of this area of the Pacific OCS.

Although evidence for benthic community disruption in oceanic areas from oil spills is small, the potential for some disruption in this area is the highest in comparison with the other proposed lease areas. Much of the oil from an oil slick suspended over a shallow area (Bishop Rock) during rough seas would be forced, by the surf, to the bottom and oil the benthic, particularly epifaunal, organisms. Many of these organisms are probably quite sensitive to pollutants because of the pristine conditions in which they live. Some may be endemic to the hard bottoms of these offshore banks while others may be the 1^{o} endemics discussed previously. Under these circumstances, it is not improbable that certain species would become extinct as a result of a spill. Pipeline construction may impact hard bottom communities, such as purple coral.

f) Intertidal Communities

Although Bishop Rock breaks the surface during low tide, this proposed lease area is essentially subtidal and is therefore discussed under the benthic summary.

2. Alternative Areas Available for Leasing Within Southern California Borderland Area

This alternative involves the availability of acreage within the southern California Borderland area which could be substituted for acreage tentatively selected as the proposed sale area. In other words, this is not an alternative to holding an OCS lease sale, but poses, instead, alternative leasing areas for the proposed sale.

In tentatively selecting tracts for the proposed sale of Federal offshore leases in southern California, the Bureau of Land Management sought to fashion a logical, reasonably-sized area for the proposed sale that would: (1) meet the OCS leasing objectives of providing orderly and timely resource development, protection of the environment, and a fair return for the resource leased; and (2) afford the opportunity needed, in the course of further study of potential environmental impacts of the sale proposal, to prepare an environmental impact statement in the detail required for a site-specific impact study.

Tentative tract selections for a proposed sale totaling approximately 1.55 million acres were made from the same 7.7 million acres included in the call for nominations. A very substantial portion of the non-selected balance of 6.1 million acres was not considered to be reasonably situated for inclusion in a proposed lease sale at this time, and was not included in the proposal formulated within the Department. Lands so excluded may be placed in the following categories:

1. Acreage in the amount of 985,000 acres was not nominated by any of the companies responding to the call for nominations, nor was it the subject of independent information in the possession of the Geological Survey which indicated that this acreage held promise for oil and gas development and production. In the absence of an expression of interest in leasing such acreage on the part of the oil and gas industry or some independent showing of resource potential, there is no reason to include the lands in a potential lease sale.

2. Acreage in the amount of some 50,800 acres is situated in a 3/4 mile belt surrounding State offshore lands which are included within State sanctuaries and as to which the State has decided to hold leasing in abeyance. This acreage would, in the event of Federal leasing, provide a "buffer zone" to prevent drainage from lands that the State has expressly decided to withhold from State leasing.

This acreage could be substituted for some of the acreage included in the proposal and would, if a decision were made to hold a lease sale, subject State sanctuaries to potential drainage from development and production on adjoining Federal land. If drainage occurred, the State would have to lease State lands within the sanctuaries to prevent the drainage.

3. The area offshore of southern California is heavily used by the Department of Defense for defense operations and activities. Acreage totaling 4,468,729 acres otherwise available for leasing consideration was not included in the sale proposal formulated within the Department. Such acreage was not included because it is situated

in areas where the Department of Defense considers potential lease development and production to be incompatible with critical defense operations and activities. The Department of Defense feels that, at this time, oil and gas leasing would be a potential source of major disruption to defense operations and activities and could have a critical impact on the nation's defense posture.

In addition to areas previously discussed, there is a large block of Federal OCS lands offshore of San Diego. This acreage was not included in the call for nominations of tracts for potential leasing within the southern California Borderland area, and, consequently, not included in the proposed sale area. The area in and near San Diego is the locus of very heavy defense operations and activities and contains a heavy concentration of military bases and facilities. These lands, which are otherwise available for leasing consideration, were not included in the proposal for a lease sale because the Department of Defense, in its discussions with officials of the Department of the Interior, did not include this area among those where it considered potential leasing to be compatible with critical defense operations and activities.

The area offshore of San Diego could be substituted for acreage included in the present sale proposal, and, if substituted and eventually leased, it could create the potential to cause the major disruptions in defense operations and activities and have the critical impact on the nation's defense posture referred to above. The potential incompatibility of leasing and defense activities in this area could be eliminated or lessened by relocating defense facilities and operations.

This, in itself, would have a disruptive effect on defense operations and activities. The Department of Defense advises that the cost of relocating some defense installations and some uses would be prohibitive.

4. A large block of Federal OCS land in the southern California Borderland area is situated in deep waters. An area totaling 472,875 acres of the 7.7 million acres identified in the call for nominations for potential leasing in the southern California Borderland area, and not included in any of the above three categories, is situated in waters exceeding 750 meters in depth. Since the technological capability to develop and produce oil and gas resoures in water depths exceeding 750 meters has not been demonstrated,[1/] the sale proposal formulated within the Department does not include these lands. There is no reason to believe at this time that potential leasing of such lands could result in oil and gas development and production in the near-term.

The deepwater tracts beyond the 750 meter contour could be substituted for acreage included in the present sale proposal, and, if eventually offered for lease, would probably result in (1) receipt of discounted bids taking into account the state-of-the-art of development and production technology; and (2) failure in the near-term to develop and produce oil and gas from these deepwater areas.

The balance of acreage remaining from the 7.7 million acres identified in the call for nominations, and not tentatively

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[1/] See discussion under the alternative to "Require Subsea Production Systems for Use on Deepwater Tracts," Section VIII.A.7.

selected for the proposed lease sale or discussed in paragraphs 1 through 4 above, amounts to about 223,000 acres (see tables below). This acreage can be considered reasonably available as alternative or substitute acreage for part of the proposed sale acreage.

The potential environmental risk associated with leasing this acreage is less than for some areas tentatively selected for the proposed sale and greater than the potential risk associated with other areas so selected. The oil and gas resource potential of this possible alternative leasing acreage is generally lower than the resource potential of similar amounts of acreage included within the proposed sale area. Thus the remaining 223,000 acres could be substituted for areas included in the proposed sale acreage which have both higher environmental risk and higher oil and gas potential.

The substantial acreage available for leasing the Santa Barbara Channel OCS area situated in southern California [1/] was excluded at the outset from the consideration leading to the formulation of the present proposal for a sale of Federal offshore leases in the southern California. This acreage was not considered by reason of the 1973 policy views of the President expressed in his energy message of April 18, 1973, which included suspension of leasing in the Santa Barbara Channel, because of concern about protecting the environment, and a request for legislation which, if enacted, would have terminated certain existing leases as well.

[1/] Although this acreage is not within the "southern California Borderland area" being discussed herein, it is referred to because of its proximity to that area.

Unleased acreage in the Santa Barbara Channel could be considered for potential future leasing whenever the Department determines that it is possible to adequately protect the environment. Should this threshold determination be made, the area would still be subject to further detailed study of the potential environmental impacts before any decision would be made as to whether or not to lease lands.

Although resource estimates, on a tract by tract basis, for the alternative acreage is incomplete at this time preliminary information appears to indicate that most alternative tracts have lower resource potential than the proposed tracts. The estimate along with a summary of potential impacts for each area are presented in Section VIII.A.1. Most of the alterntive acreage borders one of the potential lease areas. The impacts for alternative tracts will be approximately the same. (Figure VIII-2 gives the approximate location of the alternative acres available for substitution.) However, the magnitude may be changed in some instances.

1. SANTA ROSA-CORTES NORTH ALTERNATIVE ACREAGE

Alternative acreage along the southwestern border of the Santa Rosa-Cortes North area would reduce the adverse impacts for pinniped rookeries at San Miguel and ASBS for the northern channel islands since the acreage is further away. All of this particular acreage is located in 500 to 750 meter water depths. Nominations for the alternative tracts were lower than those received for all the proposed tracts in the Santa-Rosa Cortes North area.

Acreage located east and northeast of the proposed area is directly south of Anacapa Island and Santa Cruz Island along the three mile limit and contains approximately 20,000 acres. Adverse impacts will be reduced for San Miguel rookeries and the ASBS for San Miguel and Santa Rosa, but increased for the Santa Cruz and Anacapa ASBS, California brown pelicans on Anacapa Island, pinnipeds on Anacapa Island and esthetics of the national monument on Anacapa. The acreage in this section does contain tracts with 200 meter depths.

2. SANTA ROSA-CORTES SOUTH ALTERNATIVE ACREAGE

Alternative acreage near the Santa Rosa-Cortes South area would have the same impacts as the proposed area (see Section VIII.A.1).

3. SANTA MONICA BAY ALTERNATIVE ACREAGE

Alternative acreage near the Santa Monica proposed area is located on the southeastern edge of the proposed area. Adverse impacts for coastal areas would be less than for proposed tracts, but water depths would be close to 750 meters. Most of the tracts received fewer nominations than the proposed tracts.

4. SAN PEDRO ALTERNATIVE ACREAGE

Alternative acreage near the San Pedro area is located on the southern border, the southwest border and away from the southern border of the proposed area.

The alternative acreage is located further from the Southern California coast than the proposed acreage in the San Pedro area. Adverse impacts for coastal areas will be less for the San Pedro area alternative tracts. However, offshore impacts will be greater. Only a small portion of the alternative tracts in this area contain acreage in less than 250 meters.

The alternative tracts on the southwest edge of the San Pedro proposed tracts extend to the Santa Catalina three mile limit due east of Avalon. Therefore, acreage close to Santa Catalina will increase the possibility of adverse impacts for aesthetic, ASBS, recreation and other impacts for Santa Catalina described in the Santa Barbara-Santa Catalina summary (Section VIII.A.1.).

The contiguous acreage on the southern border will reduce adverse coastal impacts, but water depths exceed 500 meters.

Alternative acreage away from the southern border of the San Pedro proposed area consists of three parcels containing 1,080, 13,410 and 9,000 acres and located at 23N34W, 23N32W and 20N31W respectively. This acreage would reduce impacts described for the Santa Catalina area and the San Pedro area since it is a considerable distance south of the proposed area. The increased southerly distance would make this acreage the closest to San Clemente Island and the San Diego area. Although it would still be a considerable distance from these areas it does increase the possibility, however slight, of adverse impacts on ASBS at San Clemente and LaJolla. All of the acreage is deeper than 350 meters. It should be noted that alternative acreage located near tract 20N31W will be in or near the U.S. Navy's primary emergency aircraft ordnance jettison area.

Nominations for alternative acreage around the San Pedro area were equal to or less than the lowest nominated tract for the proposed area.

5. SANTA BARBARA-SANTA CATALINA ALTERNATIVE ACREAGE

Impacts for the alternative acreage around the Santa Barbara-Santa Catalina proposed area will be approximately the same as the impacts for the proposed areas (see Section VIII.A.1.). Water depths are greater than 500 meters and all alternative tract nominations were equal to or less than the proposed tracts in the Santa Barbara-Santa Catalina area.

Alternative acreage for the entire proposed area represents about 14% of the total proposed acreage for leasing. This acreage is scattered throughout the offshore southern California area and would probably not be substituted as a lump sum. Instead, it would be substituted for selected areas within the total proposed area.

ALTERNATIVE ACREAGE WITHIN SOUTHERN CALIFORNIA BORDERLAND AREA

Acreage Description	Millions of Acres*	
Total Acreage Subject to the Call for Nominations		7.70
Total Acreage in Proposed Sale	1.55	
Approximate Acreage Not Well Suited for Substitution:		
Acreage Not Nominated	0.99	
Buffer Zone Acreage	0.05	
Acreage in Conflict with Military Uses	4.47	
Acreage Not in above categories but subject to technological constraints (extreme deepwater)	0.47	
Total Acreage in Proposed Sale and Acreage Not Suitable for Substitution		7.53
Total Alternative Acreage Available for Leasing		0.22

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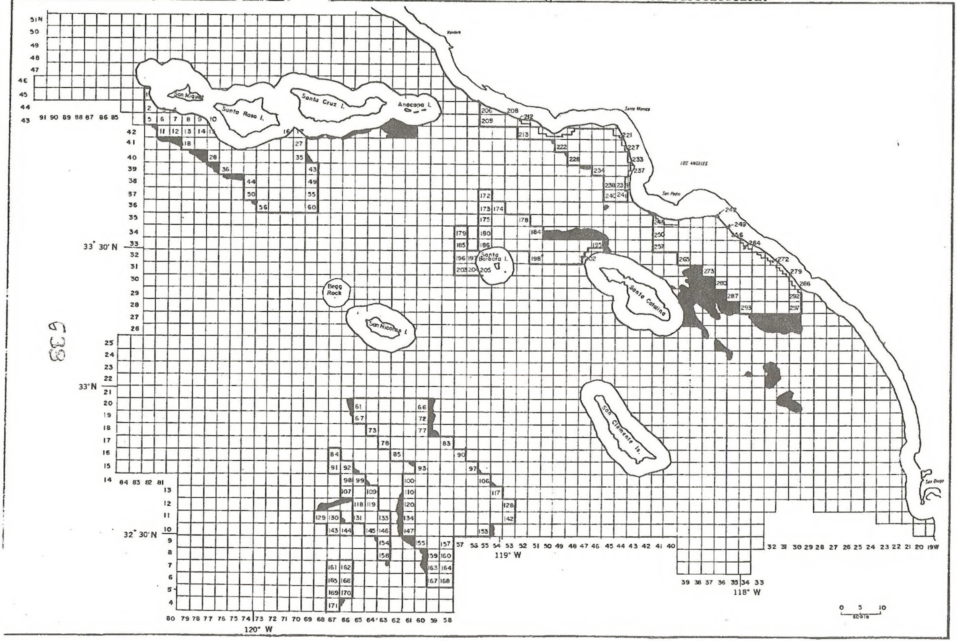
* Rounded to the nearest ten thousand.

DISTRIBUTION OF ALTERNATIVE ACREAGE AVAILABLE WITHIN SOUTHERN CALIFORNIA BORDERLAND

Area	Acreage
Santa Rosa-Cortes South	28,800
Santa Rosa-Cortes North	42,600
Santa Monica Bay	936
Santa Barbara-Santa Catalina	23,700
San Pedro Bay	126,560
TOTAL	222,596

Figure VIII- 2 Approximate Location of Alternative Acreage Available for Substitution.



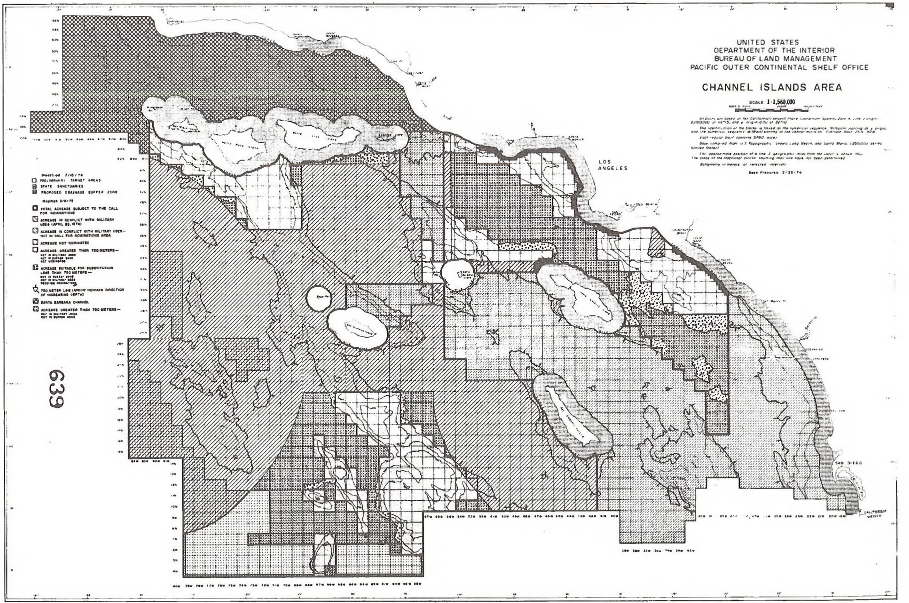

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
PACIFIC OUTER CONTINENTAL SHELF OFFICE
CHANNEL ISLANDS AREA
SCALE 1:1,560,000
All blocks are based on the California Lambert Plane Coordinate System, Zone 6, with x origin 2,000,000 at 116°15', and y origin 0.00 at 32°10'
The identification of the blocks is based on the numerical sequence N (North) starting at y origin, and the numerical sequence W (West) starting at the central meridian. Example Block 26 N 62 W
Each regular block contains 5760 acres
Base compiled from U.S. Topographic sheets Long Beach, and Santa Maria, 1:250,000 series (United States)
The approximate position of a line 3 geographic miles from the coast is shown thus. The areas of the fractional blocks abutting that line have not been determined
Bathymetry in meters at selected intervals
Base Prepared 2/28/74
Modified 7/16/74
☐ PRELIMINARY TARGET AREAS
▤ STATE SANCTUARIES
▩ PROPOSED DRAINAGE BUFFER ZONE
Modified 3/6/75
▣ TOTAL ACREAGE SUBJECT TO THE CALL FOR NOMINATIONS
▧ ACREAGE IN CONFLICT WITH MILITARY USES (APRIL 26, 1974)
▨ ACREAGE IN CONFLICT WITH MILITARY USES—NOT IN CALL FOR NOMINATIONS AREA
▦ ACREAGE NOT NOMINATED
☐ ACREAGE GREATER THAN 750 METERS—
NOT IN MILITARY AREA
NOT IN BUFFER ZONE
NOT NOMINATED
▦ ACREAGE SUITABLE FOR SUBSTITUTION LESS THAN 750 METERS—
NOT IN BUFFER ZONE
NOT IN MILITARY AREA
RECEIVED NOMINATIONS
750 METER LINE (ARROW INDICATE DIRECTION OF INCREASING DEPTH)
▩ SANTA BARBARA CHANNEL
▦ ACREAGE GREATER THAN 750 METERS—
NOT IN MILITARY AREA
NOT IN BUFFER ZONE
LOS ANGELES
SAN DIEGO
CALIFORNIA
MEXICO

Figure VIII 2a: Alternative Acreage Available for Substitution and Other Acreage Categories

3. Establish a Buffer Zone to Protect Pinnipeds and Sea Bird Rookeries

Of all the potential dangers involved in this proposed lease sale, that to pinnipeds and sea birds could potentially be the greatest (see Section III.C.3., III.D.3. and V.A.). Activities associated with platform installation, exploratory drilling and production operations off San Miguel and Santa Barbara Islands could cause significant reductions in sea bird populations and the potential elimination of sea lions, fur seals, and harbor seals from their principal breeding area in Southern California. Pinnipeds once bred in large numbers along the Southern California mainland coast, and still do in areas north of Point Conception where little or no human activity is present. Human activity in Southern California has disturbed these marine mammals to such an extent that they no longer breed at their previously established coastal rookeries.

To reduce the possibility of significant reductions of sea bird populations and possible elimination of major pinniped rookeries, the following alternative is available. No offshore structure, either temporary or permanent, will be placed closer than six (6) statute miles from the shorelines (mean high tide level) of San Miguel and Santa Barbara Islands in order to provide a minimum buffer zone for pinniped and sea bird rookeries located on these islands. This restriction includes exploratory drilling structures.

This buffer zone would reduce the possibility of ship traffic and human activity interfering with the normal behavior of the sea birds and pinnipeds and would also provide a greater time factor (see Special Stipulations Section IV.E.4.a.) needed to set up containment equipment before an oil slick could reach the shore. In the event that an oil spill does reach the shore of the rookeries, the presence of spill cleanup crews and equipment could cause more damage to the pinnipeds than the spill itself because of the disturbance created. The presence of offshore structures near the rookeries would also attract sport fishermen and would provide a stopping-off point for other recreational boaters, thereby increasing the likelihood of disturbing the pinnipeds.

Acreage affected by this alternative is indicated below:

Rookeries

Tract Area	Acreage Presently Offered	Acreage Carrying Restrictions	Acreage Remaining
San Miguel Island	291,500	37,058	254,442
Santa Barbara Island	180,400	41,033	139,367

This alternative would require the restriction of activity on all or portions of the following tracts:

Santa Rosa - Cortes North Tracts

1,2,3,4 = All

5 = N½, NE¼ SW¼, N½ SE¼, SE¼ SE¼

6,7,8 = All

9 = NW¼, SW¼

12 = NE¼ NW¼, N½ NE¼, SE¼ NE¼

13 = N½ N½

14 = NW¼

Santa Barbara Tracts

180 = SE¼, NE¼ SW¼, S½ SW¼

181 = S½

182 = NW¼ SW¼, S½ SW¼, S½ SE¼

185 = SE¼ SE¼

186, 187, 188 = All

189 = NW¼ NW¼, S½ NW¼, SW¼, NW¼ SE¼, SW¼ SE¼

196 = NE¼, SE¼

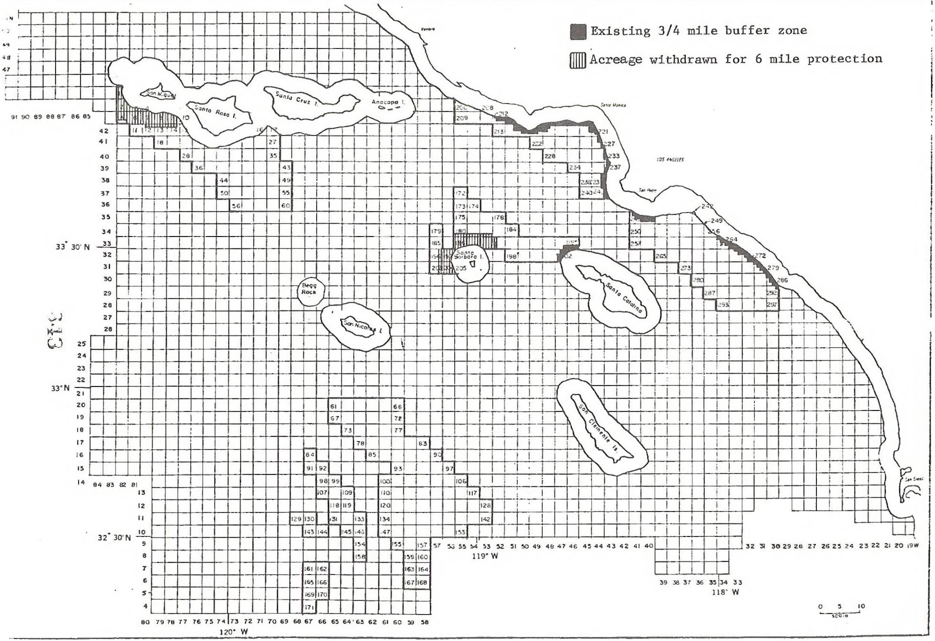
197 = All

203 = NE¼, N½ SE¼, SE¼ SE¼

204, 205 = All

The restriction of development activity on this acreage will result in effective deletion of some tracts and the partial development of others. The extent to which the tracts can be developed will depend on the nature and location of the producing structures and on the directional drilling capabilities of the operator. The removal of this acreage from the sale would, of course, reduce the amount of recoverable reserves available in the sale. The exact amount of this reduction is not known at this time.

Figure VIII-3 Six Mile Buffer Zone for Protection of Pinniped Rookeries.



4. Delete Tracts to Protect Areas of Special Biological Significance (ASBS).

The state of California has expressed concern regarding certain unique coastal areas which have been designated by the California Water Resources Control Board as Areas of Special Biological Significance (ASBS). These areas are defined as "those areas containing biological communities of such extraordinary, even though unquantifiable, value that no acceptable risk of change in their environments as a result of man's activities can be entertained." The boundaries of these areas generally extend from shore seaward for one (1) mile or to the 300 foot contour whichever is the greatest distance. Since most areas are relatively steep, the boundary is usually one mile seaward of the ASBS.

The presently proposed lease sale includes blocks which are within two miles of ASBS boundaries. This close proximity could result in serious pollution of these areas in case of an oil spill or accidental dumping of untreated drill cuttings, muds or formation water.

This pollution problem could arise due to the difference between travel time of spills and the present response time required for deployment of containment equipment (as outlined below), and possible heavy metal contamination.

Response time required by the Vikoma Pack to reach various ASBS:

Time to reach	Point Mugu	4.9 hrs.
" " "	Point Dume	5.6 "
" " "	Western San Miguel Island	4.9 "
" " "	Santa Cruz Island	4.6 "
" " "	Santa Barbara Island	6.5 "

This table indicates the shortest response time to be 4.6 hours under ideal situations. However, allowing for minor delays, it would seem reasonable to say that five hours is the minimum practical response time at present. Under moderate wind conditions with an oil slick movement of 0.45 mph (3% of 15 mph wind) the slick would reach the nearest ASBS boundary as follows:

2 miles from area	4.4 hours
2.75 " " "	6.1 "
3 " " "	6.7 "
4 " " "	8.3 "
6 " " "	13.3 "

Under more severe wind conditions, which occur fairly often in the offshore areas, the oil slick movement would progress at between 0.7 to 1.0 mph (5% of 20 mph wind) and would reach the nearest ASBS as follows: 1/

2 miles from area	2.36 to 2 hours
3 " " "	4.3 to 3 "
4 " " "	5.7 to 4 "
4.5 " " "	6.4 to 4.5 hours
5 " " "	7.1 to 5 hours
6 " " "	8.6 to 6 "
9 " " "	12.9 to 9 "

Based on the estimated travel time for spills and the time presently required for oil spill containment equipment to reach the nearest ASBS

1/ These computations include a more extreme situation of adverse weather conditions and surface current velocities in the area than is used in the Proximity Evaluations in Section III.K. These assumptions are intentionally expanded to provide protection to the ASBS areas even in cases approaching maximum adverse wind and current velocity conditions.

boundary, the minimum buffer zone (proposed) would be 2.75 miles. This would require establishment of a 3/4 mile buffer zone between the existing 3 mile state boundary and the adjacent OCS lease blocks (see Figure VIII-3).

This 3/4 mile buffer zone would require withdrawal of the following:

Acreage to be Withdrawn for 3/4 Mile Buffer Zone

	Acres Offered	Acres Withdrawn	Acres Remaining
Santa Rosa - Cortes North	291,500	38,080	253,420
Santa Barbara	180,400	8,993	171,407
Santa Monica Bay	163,700	8,142	155,558

A description of proposed tracts or portions of tracts affected by this alternative is listed at the end of this alternative.

Because of the frequent occurrence of high winds, fog and other adverse weather conditions in the OCS area, the 3/4 mile buffer zone would often be inadequate and could require a minimum of 4.5 miles between ASBS boundaries and lease tracts. However, this distance does not allow for any extra time factor which may be required because of equipment malfunction, human error, or other factors. Therefore, based on estimated spill travel times, containment crew response times, and allowing for a safety time margin, a 5 mile buffer zone is offered as a second alternative for consideration. This would require the establishment of a 3 mile buffer zone between the existing 3 mile state boundary and the adjacent OCS lease blocks (see Figure VIII-5). This 3 mile buffer zone would require withdrawal of the following acreage:

Acreage to be Withdrawn for Three Mile Buffer Zone

Tract Area	Acreage Presently Offered	Acreage to be Withdrawn	Acreage Remaining
Santa Rosa-Cortes North	291,500	110,080	181,420
Santa Monica	163,700	39,822	123,878
Santa Barbara-Catalina	180,400	56,873	123,527
San Pedro	280,000	20,880	259,120

A description of proposed tracts or portions of tracts affected by this alternative is listed at the end of this alternative.

Adoption of a buffer zone would further mitigate the possible pollution of ASBS's which, as their definition sets forth, are of such extraordinary value that no change in their environments as a result of man's activities can be entertained.

The possible magnitude of pollution resulting from a large oil spill is such that these areas could hypothetically be changed to such an extent that their unique value would in effect be lost forever.

Tracts Withdrawn for 3/4 Mile Buffer Zone Around Areas of Special Biological Significance

Santa Rosa-Cortes North

1 = All

2 = N½NW¼, SE¼NW¼, NE¼SW¼, NE¼, SE¼

3, 4 = All

6 = N½N½

7 = N½NW¼, NE¼

8 = N½

9 = N½, N½SE¼, SE¼SE¼

10 = All

14 = NE¼NE¼, SE¼NE¼

15 = N½, N½SW¼, SE¼SW¼, SE¼

16 = All

17 = N½, N½SW¼, SE¼SW¼, SE¼

20 = NE¼, NE¼SE¼

21 = N½, N½SW¼, SE¼SW¼, SE¼

22, 23, 24 = All

25 = N½, N½SW¼, NW¼SE¼

26 = N½N½, S½NW¼

27 = NE¼NE¼

29 = NE¼NE¼

30 = N½

31 = NW¼, N½NE¼, SW¼NE¼

32 = NW¼NW¼

SANTA MONICA

206 = N½, N½SE¼

207 = N½, N½SW¼, SE¼SW¼, SE¼

208 = All

210 = NE¼NE¼

211 = N½NW¼, SE¼NW¼, NE¼, NE¼SE¼

212 - SW¼NW¼, NW¼SW¼

SANTA BARBARA

186 = S½

187 - S½

188 = SW¼, SW¼SE¼

197 = NE¼, SE¼

204 - NE¼, N½SE¼, SE¼SE¼

205 = All

Tracts Withdrawn for Three Mile Buffer Zone Around Areas of Special Biological Significance

Santa Rosa - Cortes North

1, 2, 3, 4 = All

5 = N½, NE¼SW¼, N½SE¼, SE¼SE¼

6, 7, 8, 9, 10 = All

12 = NE¼NW¼, N½NE¼, SE¼NE¼

13 = N½

14, 15, 16, 17 = All

19 - NE¼NW¼, NE¼, NE¼SE¼

20, 21, 22, 23, 24, 25, 26 = All

27 = N½, N½SW¼, SW¼SW¼, SE¼

28 = N½NW¼, NE¼

29 = N½, N½SW¼, SE¼SW¼, SE¼

30, 31 = All

32 = N¼, SW¼, N½SE¼, SW¼SE¼

33 = N½, N½SW¼

34 = NW¼, NW¼NE¼

35 = NE¼NE¼

36 = N½NE¼

37 = N½N½

38 = N½N½

195 = All

196 - NE¼, SE¼

197 = All

201 = SE¼NW¼, NE¼, SE¼, NE¼SW¼, SE¼SW¼

202 = All

203 = NE¼, N½SE¼, SE¼SE¼

204, 205 = All

The removal of this acreage from the sale would, of course, reduce the amount of recoverable reserves available in the sale. The exact amount of this reduction is not known at this time.

SANTA MONICA

206, 207, 208 = All

209 = N½NW¼, SE¼NW¼, NE¼, NE¼SE¼

210 = N½, N½SW¼, SE¼SW¼, SE¼

211, 212 = All

213 = N½, NE¼SW¼, N½SE¼

214 = N½, N½SW¼, SE¼SW¼, SE¼

215, 216 = All

222 = N½, N½S½

SAN PEDRO

271, 272 = All

277 = NE¼NW¼, N½NE¼, SE¼NE¼

278 = N½, SE¼, N½SW¼, SE¼SW¼

279 = All

284 = N½NE¼

285 = N½, N½SW¼, SE¼SW¼, SE¼

SANTA BARBARA - SANTA CATALINA

180 = SE¼, NE¼SW¼, S½SW¼

181 = S½

182 = NW¼SW¼, S½SW¼, S½SE¼

185 = SE¼SE¼

186, 187, 188 = All

189 = NW¼NW¼, S½NW¼, SW¼, NW¼SE¼, SW¼SE¼

193 = S½SE¼

194 = NE¼NW¼, S½NW¼, NE¼, S½

Figure VIII-5 Three Mile Buffer Zone for Protection of Areas of Special Biological Significance.

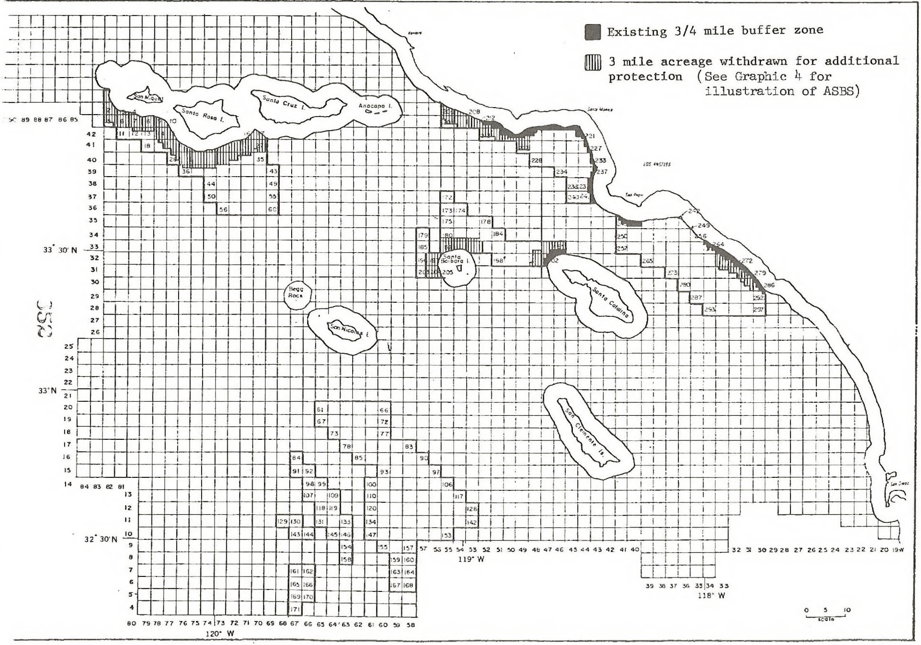
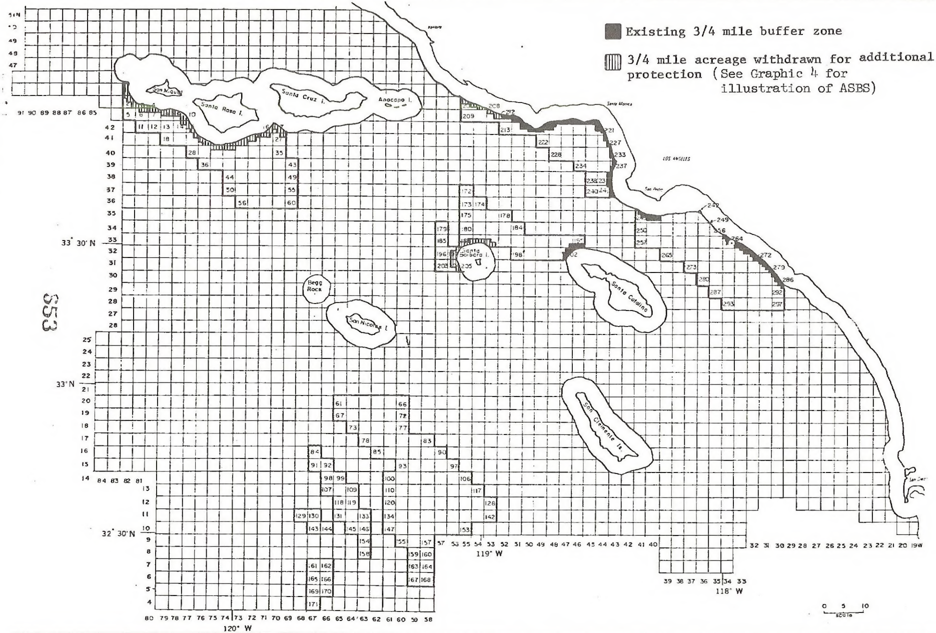


Figure VIII-4. 3/4 Mile Buffer Zone for Protection of Areas of Special Biological Significance.



5. Modify Lease Tracts to Preserve Aesthetics and Coastal Viewshed

In order to preserve the aesthetics of the coastal viewshed, permanent above surface production, transportation, or associated facilities could be prohibited within ten (10) nautical miles of the shoreline in the Santa Monica and San Pedro Bay tract areas excluding ranges 35 through 39.

The tracts affected by this alternative are depicted in Figure VIII-6. This alternative would affect the following acreage:

Acreages Affected to Protect Viewshed

	Acreage Offered	Acreage Deleted	Remaining Acreage
San Pedro Bay	280,000	87,840	192,160
Santa Monica Bay	163,700	138,140	25,560

A description of the proposed tracts or portions of tracts affected by this alternative is listed at the end of this alternative.

Adoption of the alternative would help preserve the aesthetics for the above tracts. This would reduce the visual impact of OCS development upon recreation, tourism and shoreline residences. At a distance of ten miles or greater, the angle subtended by a platform, both vertically and horizontally is relatively small and its bulk is more or less subdued by the rest of the scene. Even though visible, it tends to become a less dominant object. In Santa Monica Bay, a platform will be visible in the winter, 88% of the time at 5 miles and visible at 10 miles between 30 and 88% of the time. Summer visibilities are similar though the range is less. San Pedro Bay is similar, being visible at 5 miles in winter 71% of the time and 76% of the time in summer.

This alternative could preclude production from some of these tracts, unless accomplished by subsea completions, but would result in preservation of the aesthetic quality of the coastal view. Refer to the description of subsea and deepwater technology in Section I.G. and the discussion of potential impacts from subsea completions in Section III.A.1.

Pipelines would not be affected by this alternative so that subsurface transportation of oil and gas from more distant tracts would not be precluded.

Santa Monica Bay

206 thru 224 = All

225 = N½, N½S½, SE¼SE¼

226, 227 = All

231 = N½, NE¼SW¼, SE¼SE¼, SE¼

232, 233 = All

235 = NE¼NW¼, SE¼NW¼, NE¼, S½

236, 237, 238, 239, 240, 241 = All

San Pedro Bay

243, 244 = All

250, 251 = All

257 = N½NW¼, SE¼NW¼, NE¼

258 = N½

264 = All

270, 271 272 = All

276 = N½, N½SW¼, N½SE¼, SE¼SE¼

277, 278, 279 = All

283 = NE¼NW¼, NE¼, NE¼SE¼

284, 285, 286 = All

290 = NE¼NW¼, NE¼

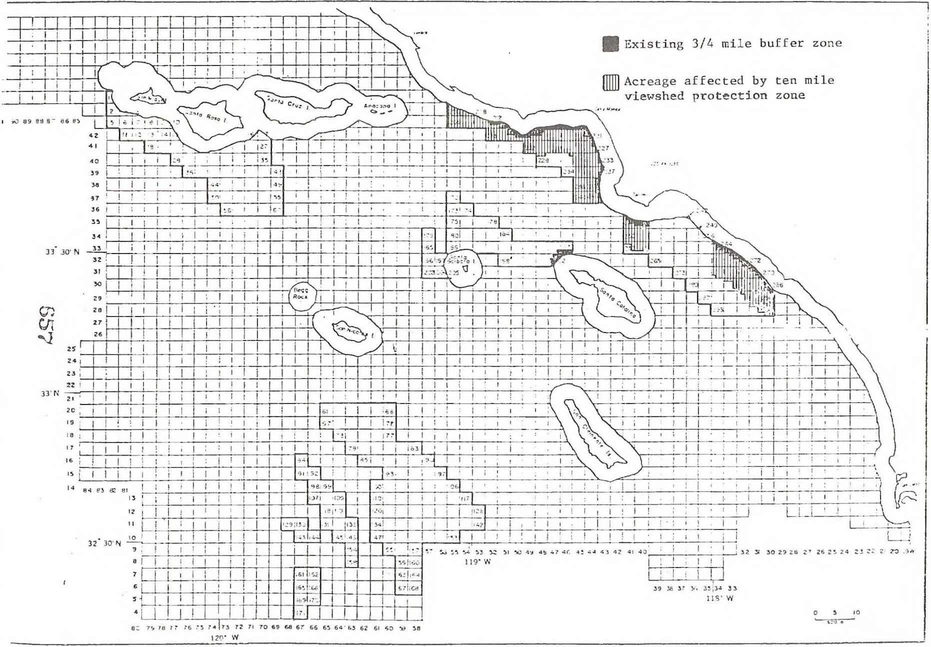
291 = N½, N½SW¼, SE¼SW¼, SE¼

292 = All

296 - N½NE¼

297 = N½, NE¼SW¼, N½SE¼, SE¼SE¼

Figure VIII-6 Ten Mile Viewshed Protection Zone



6. Delete Portions of Tracts to Establish a 3/4 Mile Buffer Zone Around the State Oil Sanctuary Surrounding the Northern Channel Islands

The state of California has established state oil sanctuaries along the mainland coast and around the Channel Islands (see Figure VIII-7.). These sanctuaries are directly adjacent to some of the proposed OCS lease areas so that production of these OCS areas could result in the draining of the affected sanctuaries which would then require their development. See section IV.A.7. for a detailed discussion of Buffer Zones.

As a means of protecting these sanctuaries from drainage all OCS tracts bordering such sanctuaries could be withdrawn for a distance of three quarters (3/4) of a mile.

This 3/4 mile buffer zone already exists in most areas but is absent around the south side of the Northern Channel Islands (Figure VIII-7.). To insure protection of the sanctuaries the following acreage would be removed from the proposed lease sale:

Sanctuary Protection

Tract Area	Acreage Presently Offered	Acreage to be Withdrawn	Acreage Remaining
Santa Rosa-Cortes North	291,500	38,080	253,420

A description of the tracts or portions of tracts affected by this alternative is listed below:

Santa Rosa - Cortez North

1 = All

2 = N½ NW¼, SE¼ NW¼, NE¼ SW¼, NE¼, SE¼

3,4 = All

6 = N½ N½

7 = N½ NW¼, NE¼

8 = N½

9 = N½, N½ SE¼, SE¼ SE¼

10 = All

14 = NE¼ NE¼, SE¼ NE¼

15 = N½, N½ SW¼, SE¼ SW¼, SE¼

16 = All

17 = N½, N½ SW¼, SE¼ SW¼, SE¼

20 = NE¼, NE¼ SE¼

21 = N½, N½ SW¼, SE¼ SW¼, SE¼

22, 23, 24 = All

25 = N½, N½ SW¼, NW¼ SE¼

26 = N½ N½, S½ NW¼

27 = NE¼ NE¼

29 = NE¼ NE¼

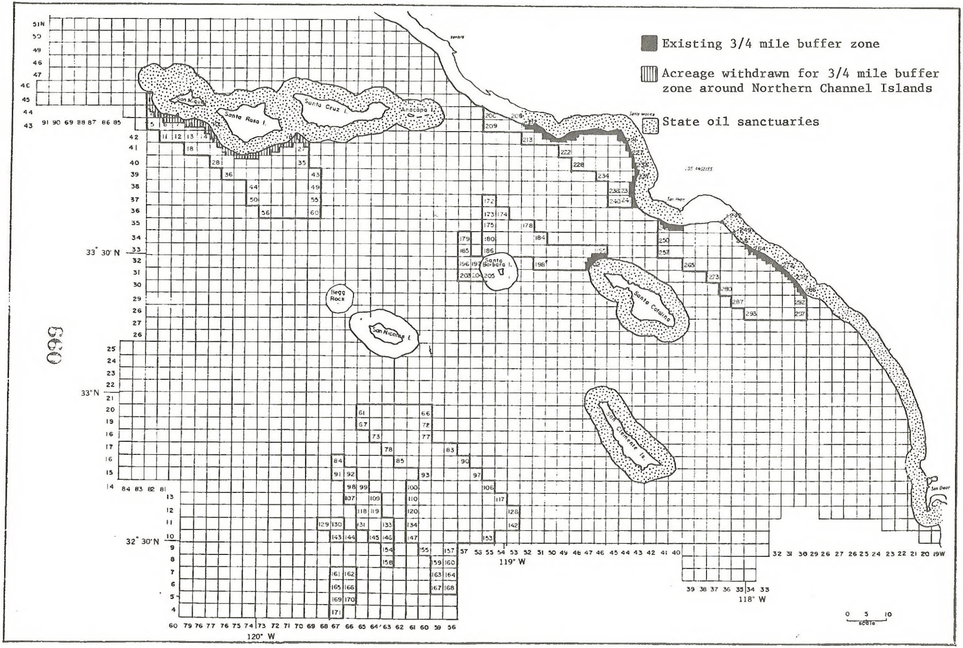
30 = N½

31 = NW¼, N½ NE¼, SW¼ NE¼

32 = NW¼ NW¼

The removal of this acreage from the sale would, of course, reduce the amount of recoverable reserves available in the sale. The exact amount of this reduction is not known at this time. Another effect of this alternative would be to protect the nearby ASBS as discussed in VIII.A.4.

Figure VIII-7. 3/4 Mile Buffer Zone Around Northern Channel Islands



7. Delete Certain Deep Water Tracts Because Existence of Development Technology Has Not Been Conclusively Established

A substantial number of tracts proposed for lease sale are situated in deep water. At present, it is estimated that production capability can be extended to water depths of 1200 feet using substantially proven surface development technology. Operations in water depths of more than 1200 feet would most likely be accomplished by subsurface methods. At this time, although substantial experiementation has been performed on subsurface development and production techniques, existence of environmentally safe technology has not been conclusively demonstrated. See earlier discussion in Section 1.

The Secretary could decide, in these circumstances, to delete from the proposed sale all tracts which are situated in water depths of more than 1200 feet. Adoption of this alternative would result in the elimination of approximately 855,000 acres from the proposed sale, and the elimination of an unknown but possibly substantial portion of the estimated oil and gas resource potential of the proposed lease area. It would also eliminate all potential impacts described in Section III associated specifically with lease operations on such tracts.

Pipelining or barging of production would still be necessary from each of the five tract areas. However, the deletion of deepwater acreage in the Santa Rosa-Cortes South and Santa Barbara-Santa Catalina areas may reduce the resource potential of these areas so that laying a pipeline to shore through very deep water may not be economically feasible, ensuring that any production from the tracts remaining in these areas would be barged. The reduction in available tracts and in the amount of available reserves would, of course, reduce the need for gathering pipelines, but it cannot be determined as yet whether production would be reduced sufficiently to reduce the number of pipelines going ashore.

Adoption of this alternative could reduce the amount of deepwater acreage available to industry for exploration and development purposes and thereby retard the development of environmentally safe deepwater technology. However, it would eliminate, for the present, the risk of failure of a deepwater drilling rig or production system and the attendant impacts.

8. Defer Proposed Lease Sale as to Certain Deep-Water Tracts Until Existence of Development Technology is Conclusively Established.

For the same reasons set forth in Alternative No. 7 above, the Secretary could adopt an alternative to defer the proposed lease sale of certain deep-water tracts viz., tracts situated in water depths more than 1,200 feet deep, except for a small number of such tracts which would become the subject of a prototype program. The Secretary could decide to lease a limited number of deep-water tracts. The purpose of such program would be to allow an opportunity for the demonstration of environmentally safe deep-water development and production technology under a small number of closely monitored operations.

Generally speaking, a prototype program for development of/new energy sources is beneficial where an incentive is necessary to spur technology evaluation in areas of energy source production of substantial interest to the nation. An example would be a situation where, because of the large expenditure of funds necessary to develop the new technology and large potential capital investment requirements as measured against the potential return, an energy industry has not shown sufficient interest, on its own, to develop the new technology. The types of information sought under a prototype program would include the following categories:

Technical information necessary to:

Verify plant design
Establish operating procedures
Establish plant reliability

Environmental information on:

- Extraction and reclamation operations
- The performance of emissions control technology
- Resource utilization such as water
- Community impacts

Economic information on:

- Construction costs including both institutional delays as well as manufacturing delays and costs
- Operating costs, including retrofit operations, replacement requirements, and efficiency
- Market value of the produced product.

Some of the information referred to above has been obtained by the oil and gas industry in the experimentation on deep-water development technology conducted to date. Other categories of information needed to assess whether environmentally safe deep-water development technology exists has not been demonstrated to exist. The industry has expended a substantial amount of funds in an effort to develop deep-water development and production techniques and its efforts to date indicate a substantial interest in perfecting this technology. Considerable progress has been made in obtaining the requisite technology. See the earlier discussion on subsea development and production technology in Section I.G., "Deep Water and Subsea Production Systems."

If the Secretary were to adopt this alternative, it would result in a substantial reduction in the potential environmental impacts of the proposed sale as discussed in Section VIII.A.7. This follows from the circumstance that deep-water tracts situated in water depths of more than 1,200 feet, except as to those included in a proposed prototype program would be eliminated for the present from the proposed sale.

The disadvantages in adopting this alternative involve the deferral of the proposed sale of tracts containing an unknown but possibly a substantial amount of the estimated potential oil and gas reserves of the proposed sale area and, consequently, a potential reduction in the amount of oil and gas production that could be generated for domestic energy needs in the short-term. Moreover, since the number of potential lessees with a need to demonstrate environmentally safe deep-water development and production technology would be very limited, the amount of potential experimentation conducted on such technology would most likely be reduced substantially. As noted under Alternative No. 7 above, if deep-water tracts were leased, a lessee would be required under present regulations and OCS Operating Orders to file a plan of development describing proposed development and production operations. In order to gain approval of such plan, the lessee would have to establish to the satisfaction of the Oil and Gas Supervisor of the Geological Survey, that his proposed development and production technology is environmentally safe.

B. Withdraw the Sale

In addition to modifying the proposed sale, cancelling or severely restricting the sale presents another policy option for consideration. Such action would reduce the contribution of these potential OCS oil and gas reserves to meeting the energy needs of the United States. Optional sources and their environmental impacts are discussed on the following pages.

In the next five to fifteen years, the oil and gas available from the proposed sale could provide significant additions to the nation's domestic production. Energy availability is the current target of concentrated research as shown in a later section.

The following is a list of energy sources or actions which might be employed as substitutes to OCS oil and gas if the subject sale were either cancelled or severely limited in scope:

1. Energy conservation
2. Conventional oil and gas supplies (onshore-domestic)
3. Coal
4. Coal conversion
5. Oil shale
6. Nuclear power
7. Solar energy
8. Energy imports
9. Geothermal
10. Hydroelectric power
11. Other energy sources
12. Combination of alternatives

Each of the items is discussed briefly in the pages that follow. (A more detailed study of long-term optional energy sources and of energy conservation can be found in Energy Alternatives: A Comparative Analysis, prepared by the University of Oklahoma for the Bureau of Land Management, Department of the Interior. Note that the discussion will consider the option of energy conservation as an alternative to the energy supplies resulting from this sale as well as the possibility of substituting other energy forms for OCS oil and gas.

The following tables gives the energy equivalent which will be used in this discussion and the relative costs associated with each energy source.

Energy Needed From Other Sources To Replace The Expected Oil And Gas Production From The Proposed California OCS Sale #35 1/

					Range		
1. Btu Equivalents 2/	in billions of Btu's per day			Low		High	
Oil -	100,000	to	1,000,000 bbl/day	.58		5.798	trillion Btu/day
Gas -	0.16	to	1.92 bil. cu. ft/day =	.165	to	1.981	
Total				.75		7.78	

		Range		
2. Oil Equivalents	in barrels per day			
Oil from other sources needed to directly replace expected oil production from California sale #35		100,000	to	1,000,000 bbl/day
Oil from other sources needed to replace expected gas production from California sale #35		28,500	to	341,550
Total		128,500		1,341,550

1/ Assume production over 40 year period.
Oil 1.6 - 14.0 billion barrels
Gas 2.4 - 28 trillion cubic feet of gas

2/ Conversion factors used:
1 barrel of oil = 5.8×10^6 Btu
1 cubic foot of natural gas = 1,032 Btu
1 cubic foot of natural gas = 1.78×10^{-4} barrel oil
1 barrel of oil = 5.62×10^3 cubic feet of natural gas
1 ton of coal = 24×10^6 cubic feet of natural gas
1 kilowatt hour = 3,412 Btu at the theoretical conversion rate of other energy forms to electricity at 100% efficiency.

	Range		
3. Gas Equivalents in billions of cu. ft. per day	Low		High
Gas from other sources needed to replace expected oil production from California sale #35	.562	to	5.62 bcf/day
Gas from other sources needed to directly replace expected gas production from California sale #35	.16	to	1.92 bcf/day
Total	.722		7.54 bcf/day
4. Coal Equivalent in thousands of short tons per day			
Coal	24	to	242 thousand short tons/day
5. Electrical Equivalents in thousands of megawatts of capacity			
Substitute for end uses 1/	8.8	to	93.5 thousand Mw
Substitute as input to electicity generation 2/	5.4	to	57.6 thousand Mw

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1/ Based on a 65% average efficiency of end use of oil and gas (such as oil and gas heating) and a plant load factor of 80%.

2/ Efficiency of fossil fuel electricity generation was assumed to be 40%.

Comparison of Energy Costs

by Source

Energy Resource	Market Cost Per Million Btu's for end Uses	Cost of Producing 1Kilowatt Hour (KWH) of electricity in Mils($.001=1 Mil 1KWH=3,412 BTU)	Cost Per Equivalent Barrel of Oil(5.8MM Btu's =1 Bbl Oil)
Coal 1/	$ .48 to $ .60	4 to 5 Mils	$ 2.80 to $ 3.50
Natural Gas 3/	.50 - .60	4 - 5	2.90 - 3.50
OCS Oil (Sale #35) 3/	1.70 - 1.90	14 - 16	10.00 - 11.00
Imported Oil 3/	1.90 - 2.10	16 - 18	11.00 - 12.00
Oil Shale 1/	1.80 - 2.50	15 - 21	10.50 - 14.50
Imported LNG 3/ (At $2.00 per 1000 Cu.Ft.)	1.95 - 1.95	17 - 17	11.25 - 11.25
Synthetic Oil From Coal 1/	2.00 - 2.50	17 - 21	11.60 - 14.50
Synthetic High Btu gas 1/ from coal	2.50 - 4.00	21 - 34	14.50 - 23.20
Nuclear 4/, 2/	1.50 - 3.20	5 - 11	8.50 - 18.60
Hydropower 4/	.90 - 3.20	3 - 11	5.20 - 18.60
Geothermal 4/	.70 - 1.30	2.4 - 4.5	4.00 7.50

1/ Source: **Sidney Katell**, U.S. Bureau of Mines - Process Evaluation Group

2/ The high cost of produding Btu's for end uses using nuclear power is due to the fact that the heat produced by a nuclear reactor cannot be used directly but must first be used to generate electricity.

3/ Dames and Moore, Job No. 2390-006-02

4/ U.N Symposium on the Development and Utilization of Geothermal Resources, Pisa 1970. Vol. 2, Part 1, pp. 971.

1. Energy Conservation

Vigorous energy conservation is an alternative that warrants serious consideration. The Project Independence Report of the Federal Energy Administration claims that energy conservation alone can reduce energy demand growth by 0.7 to 1.2 percent depending on the world price of oil. Aside from these savings, it is now widely recognized that wasteful consumption habits impose social costs such as pollution and an inequitable distribution of fuel, that can no longer be afforded.

The residential and commercial sectors of the economy are often characterized as inefficient energy consumers. In the next 30 years, their share of total energy use is expected to increase from 32 to 39 percent in the State of California alone. Inadequate insulation, inefficient heating and cooling systems, poorly designed appliances, and excessive lighting are often noticed in these sectors. To achieve reductions in consumption beyond those induced by fuel price increases could require new standards on products and buildings, and/or subsidies and incentives. These incentives could impose standards for improved thermal efficiency in existing homes and offices and minimum thermal standards for new homes and offices.

Excessive consumption is also evident in the industrial sector where energy inefficient work schedules, poorly maintained equipment, use of equipment with extremely low heat transfer efficiencies, and failure to recycle heat and waste materials are all commonplace. Estimated energy savings of between 10 and 30 percent may be available in this sector of the economy.

Transportation of people and goods accounts for approximately 25 percent of nationwide energy use and nearly 35 percent in California. Energy inefficiency in the transportation sector varies directly with automobile usage. Automobiles, which account for 90 percent of all passenger movement in the nation, use more than twice as much energy per passenger mile as buses. Moreover, the average car carries only 1.3 passengers. Using short and mid-term conservation measures such as consumer education, lower speed limits, rate and service improvements on public transit and rail freight transit, energy savings of 15-25 percent might be possible. For example, the California Department of Transportation has estimated that a three percent reduction in fuel consumption in 1974 resulted from the lower speed limit on California highways.

Other policies to encourage fuel conservation in transportation could include standards for more efficient new autos and incentives to reduce miles traveled. An important new development in the fuel economy area could be the modification of the standard internal combustion engine. Although such an engine is now in the advanced stages of development, further study by automotive engineers, industry, and concerned Federal Agencies is necessary before an acceptable engine may be approved.

Significant energy savings are clearly possible through accelerated conservation efforts. The Project Independence Report estimates that conservation alone could result in a 2.2 million barrel per day reduction in petroleum demand by 1985. These savings will be necessary in order to achieve the goals of energy self-sufficiency.

California Coastal Zone
Conservation Commission Energy Conservation Policy

The California Coastal Zone Commission has recommended a number of energy conservation policies in its preliminary Coastal Plan. They are presented below by policy number.

121. Restructure Utility Rates to Encourage Conservation. Utility rates should be restructured to encourage energy conservation and peak load demand reduction. The California Public Utilities Commission (CPUC) should revise rate structures to more accurately reflect the actual costs of production and transmission of a customer's gas and electricity. The State Energy Commission should assist the CPUC in the revisions as soon as it is able to do so. (E-p2)

122. Reduce Energy Consumption Statewide and in Coastal Developments. Non-essential consumption of energy should be reduced statewide, thereby reducing the adverse environmental impact of energy supply facilities on the coastal zone. (E-p4)

a. Statewide Energy Conservation Measures Recommended. The energy conservation standards contained in Policies 123 through 126 below clearly should be applied statewide and are therefore recommended to the State Energy Resources Conservation and Development Commission ("State Energy Commission") for its consideration in developing statewide energy conservation measures in fulfillment of its legislative mandate. (E-p4)

b. Coastal Energy Conservation Standards May Also be Applied. If, for any reason, a significant energy conservation program is not in effect statewide by January 1, 1977, then the standards set forth in Policies 123 through 126 below, or any imporvement upon them recommended or enacted by the Energy Commission, shall be applied by the coastal agency to all development proposed within the agency's jurisdiction. Until that time, the application of such standards should be required to the maximum extent feasible in any development as a contribution to energy efficiency and resource conservation. (E-p4)

123. Reduce Consumption of Electricity for Lighting. Unnecessary lighting in new or substantially remodeled residential, commercial, institutional, or industrial development shall be reduced through State Energy Commission action (or by the coastal agency within its jurisdiction--see Policy 122) in the following ways. (E-p5)

a. Regulate Lighting Levels. Lighting shall not exceed 2.3 watts (2.5 volt-amperes) per square foot except in instances where higher levels are shown to be necessary for high visual acuity tasks and public health and safety.

b. Allow Only Efficient Lamps and Luminaires. Only efficient lamps and luminaries, as defined in the proposed Standard 90-F of the American Society of Heating, Ventilating, Refrigeration, and Air Conditioning Engineers (ASHRAE), shall be allowed.

c. Provide for Selective On-Off Light Switching. In large office buildings, light switches shall be provided so that portions of the building, including portions of each floor, receiving adequate natural light, or not in use, can be switched off selectively.

d. Use HPS Street Lighting. New street and highway lighting luminaries shall be of the high pressure sodium (HPS) type, or an approved alternative type equal in energy efficiency, unless there are environmental, aesthetic, or public safety reasons for utilizing a different type of light source. (E-p5) Consideration should be given to establishment of a capital improvement fund, by passage of a State bond issue or by other appropriate State funding, for the conversion of existing State, county, and municipal incandescent or mercury vapor type street and highway lighting to high pressure sodium (HPS) type or equivalent. Conversion should take place as quickly as possible given the financial resources available and manufacturing and installation capacity. Funds expended could be repaid from energy cost savings resulting from the conversion. (E-p9d) Other appropriate energy-conserving devices (e.g., astronomical clocks that eliminate lighting during daylight) and designs shall also be incorporated in all new public lighting systems. (E-p5)

e. Ban Lighted Advertising or Ornamental Signs. Proposed new advertising or ornamental signs, whether on business sites or off, shall not be electrically lighted, except that businesses shall be allowed onsite lighted identification signs containing only the name, address, and major project or service of the business, and these signs shall be illuminated during darkness only when the business is open to the public. (Incorporation of such standards in local sign ordinances, as prescribed in Policy 58, should be considered.)

f. Minimize Building and Facade Lighting. Building and facade lighting, exclusive of signs, shall be no greater than 1,000 watts or 2 per cent of the total interior lighting load of the building, whichever is greater. On-site signs and facade lighting shall be included in the project's energy budget. (E-p5)

124. Reduce Consumption of Electricity for Heating and Cooling. Unnecessary use of electricity for heating, cooling, and ventilating in new or substantially remodeled residential, commercial, institutional, or industrial developments shall be reduced through State Energy Commission action (or by the coastal agency within its jurisdiction--see Policy 122) in the following ways. (E-p6)

a. Restrict Electric Resistance Heating. No electric resistance heating (water or space) shall be allowed unless: (1) an effective solar delivery system and/or natural gas service are not available or adequate for meeting energy requirements; (2) electrical heating is needed for medical, health, or public safety reasons; (3) some other unusually high requirement for clean heat exists; or (4) a back-up system for solar heating and cooling systems is required.

b. Build to Reduce Air Conditioning Needs. Air conditioning needs shall be reduced by: (1) incorporating either mature planting, exterior architectural shading projections, or reflecting and/or insulating glass or exterior solar screens to shade or protect windows receiving direct sunlight in warm climates; (2) incorporating operable sash and vents in all exterior rooms for which ventilation is required by the local building code, and making such sash and vents weather-tight by use of weather-stripping; and (3) having variable thermostats for areas with different air conditioning requirements.

c. Use Best Available Air Conditioning Technology. An air conditioning design using the best practical available technology with low-level or no electricity consumption shall be required. New conventional compressive refrigeration air conditioning shall be permitted only if an applicant can demonstrate that the life cycle costs of the conventional system are substantially less than the lowest cost alternative system available. The demonstration shall include a comparison of the conventional and potential alternative schemes, including electric energy consumption, cooling output, and life cycle cost, together with outline specifications and sketch plans to scale for both the conventional and alternative systems. The comparison shall be submitted and signed by a California registered engineer. (Alternatives may include cooling systems based on evaporative cooling, solar cooling, nocturnal radiation, absorption refrigeration, heat pumps, rock bed regenerators, and coolness storage, among others.) (E-p6) (See the section on Alternative Energy Sources.)

125. Reduce Wasteful Consumption of Natural Gas in Pilot Lights and Gas Flames. Wasteful use of natural gas in new or substantially remodeled residential, commercial, institutional, or industrial developments shall be reduced through State Energy Commission action (or by the coastal agency within its jurisdiction--see Policy 122) in the following ways. (E-p7)

a. Use Intermittent Electrical Ignition Systems or Other Means. Intermittent electric ignition systems or other acceptable means shall be used in lieu of gas pilot lights in all residential, commercial, or industrial equipment (with the exception of water heater gas pilots) installed in proposed new construction or additions to existing structures unless it can be conclusively demonstrated that the gas pilot device: (1) has a substantially lower life cycle cost than an electric ignition or other alternative system, computed at prime interest rates; (2) that for particular equipment, the gas pilot light is more energy efficient than available alternatives; or (3) that public health or safety necessitates the use of pilots.

b. Ban Open Gas Flames. Open gas flames for advertising, promotional, or decorative purposes shall not be allowed in proposed new industrial, commercial, or residential construction or additions. This applies to both exterior and interior installations. (E-p7)

126. Establish Energy Budgets for New Developments. An energy budget code should be formulated, to be applied statewide by the Energy Commission to all new or substantially remodeled residential, commercial, institutional, and industrial developments. (E-p8)

a. Proposed Energy Budget Code Criteria. The code should set required energy budget performance levels for a range of building types, sizes, occupancies, projected levels of intensity of use, and locations. The energy budget shall state the energy inputs and outputs of the proposed building or other development in BTU's per cubic foot or in watts per square foot; and shall give the extreme mean heat loss/gain of all buildings in peak heating and cooling seasons. All proposals for enclosed developments shall include outline specifications for the following: microclimate description of the building site; microclimate modifiers such as planting; total building exterior cladding material; building insulation; building thermal inertia and energy storage capability; major building energy using and controlling equipment such as for lighting, heating, ventilating, and air conditioning.

b. Projects Requiring Energy Budget Analysis. An energy budget, including outline specifications, shall be required for residential developments of four or more dwelling units, or commercial or industrial projects of 5,000 square feet of floor area or more. It shall be signed by a California registered engineer or certified architect. Proposed light commercial structures of less than 2,700 square feet may be exempted from the specification standards without submitting an energy system analysis, provided a California registered engineer or certified architect states in writing that the specific proposed design would be expected to meet or have a lower annual energy consumption than the minimum established performance for the project type. Consideration should also be given to developing an exemption procedure for single family homes that would permit administration of energy conservation measures through local building codes without necessitating undue cost in the preparation of energy budgets.

c. Projects Meeting Budget Standard Exempt from Specification Requirements.

A proposed building or development that meets the required energy budget performance level set in the energy budget code, as shown throgh an energy system analysis, shall be exempt from such specification criteria as those described in Policies 123 through 125. (E-p8)

d. Research and Training Needed. To facilitate development and implementation of an energy budget code statewide, detailed research should be undertaken to define energy code standards, and a State-financed program of in-service training for building inspectors to administer the energy budget should be instituted. (E-p9)

e. Interim Budget Code for Coastal Developments. If the Energy Commission has not made substantial progress toward development of an energy budget code by January 1, 1977, the coastal agency shall consider adoption of an interim budget code, to be applied to all development proposed within the agency's jurisdiction. Such an interim code might be submitted by a responsible professional organization to the coastal agency for public hearing and possible adoption. If adopted, the energy budget code would be implemented through the coastal permit process in the same manner set forth above. Until January 1, 1977, the development and application of energy budgets should be encouraged as a contribution to energy efficiency and resource conservation. (E-p8)

127. Implement Other Energy Conservation Measures Statewide. The State Energy Commission and the State Legislature should, as part of a comprehensive statewide energy conservation program, implement certain other conservation measures statewide, as follows:

a. Tax Heavier, Less Efficient Autos. Tax legislation should be enacted that encourages the use of lighter automobiles with smaller engines and increased energy efficiencies. (E-p9b)

b. Discourage Inefficient Appliances. Legislation should be enacted requiring that (1) all appliances sold in California meet specified energy efficiency standards, and (2) all appliances be clearly labeled with energy efficiency or energy consumption information. (E-p9c)

c. Improved Energy Use Standards of Existing Buildings. A long-range phased program for improving the energy use standards of existing buildings in California, including replacing energy inefficient equipment, should be devised and implemented. Special loans and/or tax incentives should be considered to assist in upgrading insulation, and incorporating low or non-fuel-using technologies that involve higher capital costs. (E-p9a)

b. Environmental Impacts

The environmental impacts of a vigorous energy conservation program will be primarily beneficial. The exact nature and magnitude of these impacts will depend on whether there is a net reduction in energy use or whether the reduction is accomplished through technological change and substitutions. For the former, the net impacts will simply be that there are fewer pollutants of all kinds unleashed. As an example, the 2.2 million bbl/day savings by 1985 mentioned above would result in a diminishment of various pollutants by the following amounts. 1/

CO - 4 lbs/1000 gals = 189 tons/day
Hydrocarbons - 3 lbs/1000 gals = 142 tons/day
Particulates - 23 lbs/1000 gals = 1088 tons/day
NO_x - 60 lbs/1000 gals = 2838 tons/day
SO_2 - 157 lbs/1000 gals = 7426 tons/day

If, however, energy conservation is achieved by technological change or substitution, the net reductions will be those above, less the incremental pollutants from other sources, as well as any new pollutants which might arise from these other sources.

1/ HUD Contract #H2026R- "Research Evaluation of a System of Natural Air Conditioning".

2. Conventional Oil and Gas Supplies

Large quantities of oil still remain in the United States. The U.S. Geological Survey estimates that undiscovered recoverable resources of 135-270 billion barrels of oil are located onshore. This figure, however, is an estimate of the nation's total petroleum resource base and is not an indication of the oil supply that will be available for future consumption. The term "proved reserves" refers to those volumes of petroleum liquids that are known from drilling and are economically producible at current prices with current levels of technology. The Project Independence Report uses the American Petroleum Institute's **(Jan. 1, 1974)** annual figure on proved reserves, 35.3 billion barrels. In addition to these reserves, T. A. Hendricks, W. C. Mallory, and associates of the USGS claim that an additional 25 to 45 billion barrels of petroleum liquids could be added to proved reserves through extensions, revisions, and discoveries of new pools in known fields.

Despite the magnitude of the proved reserve estimate, domestic oil production is almost certain to continue its decline from the peak production rate attained in 1970. All of the 12 oil production forecasts discussed in the Project Independence Blueprint claimed that, in the next few years, the petroleum production decline would continue in the United States. Most of these same forecasts predict increasing domestic production by the late 1970's but only under the most favorable conditions in terms of prices, regulation, and environmental constraints.

Much of the domestic oil reserve is recoverable through secondary and tertiary extraction techniques. However, the oil that is attainable in this manner is in many cases "old" and hence subject to price controls. These controls have diminished the incentive for using these sophisticated and expensive recovery methods.

To substitute directly for the subject sale, onshore oil production would have to increase by 100,000 - 1,000,000 barrels a day and onshore gas production would have to increase by .16 - 1.92 1/ billion cubic feet a day.

Impacts

This substitution would entail environmental impacts such as land subsidence, soil sterilization, and disruption to existing land use patterns. Equipment failure, human error, and blowouts may also impair environmental quality. Moreover, poor well construction and oil spills can result in ground and surface water pollution.

The magnitude of these impacts would depend on whether the increased production resulted from improved recovery methods or new discoveries. If improved recovery is the characteristic, the impacts will likely be of little significance and will occur in already developed areas. Should new discoveries be more characteristic, and this is unlikely, the impacts will be more significant and disruptive, as the whole infrastructure will have to be built from the ground up.

1/ Low range based on 1,600 cubic ft. per day, per barrel of oil produced, high range based on 2,000 cubic ft.

The water pollutants from onshore oil production are oil and dissolved solids. The amounts of each vary over a wide range. A summary of this is available in the University of Oklahoma report "Energy Alternatives: A Comparative Analysis".

Air pollutants (particulates, NO_x, SO_x, hydrocarbons and CO) result from blowouts and subsequent evaporation and burning. These are generally insignificant, except locally. These effects will be basically the same, whether the production is on or offshore.

Land pollution can arise from spills, blowouts and other accidents, but has no extremely lasting or dire impacts. Land use can vary from 3-7 acres/10^{12} BTU/year. In this case the increased onshore production would result in a land use increment of 6400 - 14800 acres in the first year. 1/

Deregulation of the Wellhead Price of Natural Gas

The price ceiling on natural gas has resulted in a less than optimum level of gas production and, therefore, a misallocation of energy resources has developed. More expensive fuels, such as domestic oil and imported oil, have substituted for natural gas. If the price ceiling on natural gas were eliminated, a more efficient allocation of energy resources would result. Deregulation should reduce production costs of industries in which natural gas can be substituted for oil. No doubt, the price of natural gas to the consumer would increase, but in the long run, the production cost savings to industry, and the lower cost

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1/ Oklahoma: Energy Alternatives

to the consumer would more than compensate for the increases in natural gas prices. A further benefit of deregulation would be a reduction or slowing of foreign oil imports. This would help the United States Balance of Payments and make this country less-dependent on insecure foreign supplies. The OCS is believed to be one of the most prospective areas for natural gas development. But with the low ceiling price on natural gas, dry gas reserves may go undeveloped.

Environmental Impacts

Should the price of natural gas be deregulated it is presumed there will be an increased exploration and development effort for this resource. The impacts of this will include those described above for oil such as land subsidence, disruption, and land use. The impacts on water and air are less in the case of gas, but the exact amount of diminution of these impacts would depend on how much of the increased production is associated and how much is dry gas. It should be noted that accidents are more frequent with natural gas than with oil, but their effects on the environment are generally less severe. The land use impact of increased gas production are generally the same, with some increment for compression stations.

Finally, if increased production of domestic gas results in fewer imports, the dangers associated with these will be somewhat lessened.

Nuclear Stimulation of Gas Formations

Nuclear stimulation, an experimental method of fracturing low permeability gas reservoirs otherwise incapable of sustaining commercial production, has the potential to add materially to U.S. recoverable gas reserves. The Atomic Energy Commission is conducting research and development of nuclear explosives to recover natural gas locked in tight geologic formations. Such gas cannot now be produced economically by conventional methods. Most reserves which are amenable to nuclear stimulation lie in thick, deep reservoirs of very low natural permeability located in the Rocky Mountain area.

The Federal Power Commission has estimated that total yearly gas production by 1985 from the Uinta, Piceance, and Green River Basin fields using nuclear stimulation from 110 to 200 wells would be 812 to 1,939 billion cubic feet. 1/

Environmental effects of nuclear stimulation to increase natural gas production from tight reservoirs are related to radioactivity and seismic disturbance, both of which concern the surface or

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1/ Federal Power Commission, April 1973, Natural gas Technology Task Force for the Technical Advisory Committee of the Natural Gas Survey by the Federal Power Commission, p. II-7.

surface or subsurface, leaving atmospheric contamination or disturbance unlikely. The depth of the gas formations of interest throughout the Rocky Mountain area is such that the probability of releasing any appreciable amounts of radiation to the atmospheric at detonation time is considered negligible. Most of the radioactivity produced by the explosives will remain underground, trapped in the resolidified rock near the bottom of the chimney or attached to the rock surfaces in the chimney.

Project design would consider mobile waters and assure that chimneys remain isolated from them. Methods are being developed to dispose of water produced with the gas and containing low levels of tritium. The potential environmental impacts of nuclear stimulation of a single well or several wells in small geographic areas have been evaluated by the AEC, for example, for the Rio Blanco and Wagon Wheel Projects. Extrapolation to more extensive development relates to frequency and size of explosives and changes in the local environment. The possibility that residual stress from a number of detonations might accumulate and present an earthquake stimulation hazard requires continued appraisal during future nuclear stimulation projects.

3. Coal

a. Description

Coal is the most abundant energy resource in the United States. Coal deposits underlying nearly 460,000 square miles in 37 States constitute one-quarter of the known world supply and account for 80 percent of our proven fuel reserves. Proven reserves of coal contain 125 times the energy consumed in 1970.

To replace the energy expected to be realized from the proposed California sale, 8.8 - 88 million tons of coal per year would be necessary. Though domestic reserves could easily provide this quantity, serious limitations to coal development exist. In many uses, coal is an imperfect substitute for oil or natural gas. In many other cases, coal use and production is restricted by government constraints, limited availability of low sulfur deposits, inadequate mining, conversion, and pollution abatement technology, and the hazardous environmental impacts associated with coal extraction and electricity generated from coal. Coal production is also threatened by the unique set of labor problems associated with mining and new strict standards for coal mine safety.

Although U.S. coal resources are very large, as with other extractable mineral fuels, there is some geographic dislocation. Most of our coal is found west of the Mississippi River far from the concentrated industrial areas of the east and far west. Also, much of the western coal is in arid or semi-arid areas where scarcity of water could constrain development.

The portion of the demonstrated reserve base that is available for use depends on whether the coal deposit can legally be mined, and if it can, whether it is suited for underground or surface mining. Surface mines may recover up to 90% of the coal in a given mine; underground mines 50 to 60% using room and pillar methods. However, statistics indicate that at the 1972 price only 12% of the total resouce could be considered economically recoverable. As with other extractable hydrocarbons, the quantity of available coal is a function of coal's market price. Current increases in the market price for coal are making more of the resources base available for domestic consumption.

b. Environmental Impacts

Coal Utilization. The major impact from coal utilization is on air quality. Those of most concern are the emissions of SO_x and particulates. If the expected production from this sale is replaced by coal, there will be an increase in these pollutants, especially if coal is substituted for the natural gas. Technology to control these emissions is available but has not yet been proven sufficiently to be widely applied. Furthermore, much U.S. coal, and especially that near major consuming areas, has a high sulphur content. Most of the U.S. low sulphur coal is found in the western states, far from major markets. Any large scale shift to coal is constrained by the costs of alleviating these conditions.

Surface Mining. The 8.8 - 88 million tons necessary to replace this sale would require about 18 large open-pit mines (assuming 5×10^6 tons annually each). The most obvious impact here is surface disruption. This has adverse impacts on all local flora and fauna, as well as an impact on water quality and land through siltation and erosion. However, this is a temporary effect if the land can be reclaimed. Reclamation is difficult in the western states due to the lack of water to assist in revegetation. Other problems include acid mine water, leachings from spoil piles, processing waste, and the disturbance caused by access and transportation. Noise and vibration resulting from operations can also be expected. Finally, surface mining also causes conflicts with other resource uses.

The land use of strip-mining ranges from .8 - 5.9 acres/10^{12} Btu extracted, depending on seam thickness and Btu content of the coal. Assuming a ball park figure of 2 acres/10^{12} Btu, the annual surface disturbance could range from 440-4400 acres. Since this disturbance is incremental, the total impact, assuming a 20 year life could be as much as 14 - 140 square miles. Thiscontrasts with the onetime impact of an oil well.

Underground Mining. To replace the expected production from the sale, up to 45 underground mines would be required (assuming 2×10^6 annual tons each). Underground mining primarily affects land and water quality. The land impacts are those that arise from subsidence, waste disposal, and access and transportation. Very little surface is disturbed. Subsidence can destroy structures, cause landslides and earthquakes, and disrupt groundwater circulation patterns. The amount of subsidence can be controlled by the mining method used and the amount of coal removed. Both have detrimental effects on the economics of the operation.

Water quality is affected by both processing waste and the drainage of acid-mine water into surrounding areas. These can be minimized through the proper methods of control both during and after operations. Entrances can be sealed, waste piles can be replaced in the mine. This would also help minimize subsidence. Also, there are pollution problems associated with road and coal dust and the like, but these are minimal and easily controlled. Other disturbing aspects of mining have much less of an impact in an underground than a surface mine. Finally, there is also the social cost arising from the working conditions of underground mines. This is being dealt with under the Federal Coal Mining Health and Safety Act of 1969 but one result is that surface mining now enjoys an edge over underground methods, with the resulting more severe environmental hazard.

Coal Transportation

The five major transportation systems, (road, rail, water conveyor, and pipeline) all have some environmental impacts. These include air and noise pollution, safety, land use, trash disposal, and aesthetics.

Since spill problems are not associated with coal, all the impacts can be controlled easily with a little care and consideration. Additionally, a slurry pipeline requires large supplies of water and must adequately dispose of this at the other end. The impacts of drawing the water would make a pipeline infeasible in a dry area, while disposing of it either through further use or proper techniques can be made to have a minimal impact.

4. Coal Conversion

Technology for conversion of coal into gaseous and liquid hydrocarbons has been established for several decades and a number of relatively low-capacity commercial plants exist in various parts of the world. However, few cost-effective advanced technologies have advanced beyond the pilot plant stage.

Numerous problems remain before commercial development of synthetic fuels from coal can proceed. Specific technical problems must be solved. The cost-effectiveness of synthetic fuels from coal will depend on prices of other fuels, primarily oil and natural gas. Control of adverse environmental effects will increase the cost of producing synfuels. Possible constraints on development include resource constraints; availability of skilled workers, raw materials (coal, water, steel), capital; and institutional constraints: government policies (energy resource leasing, coal mining regulations, permit procedures, etc.), and the willingness of industry to invest in development of new technologies.

In order to substitute for the oil and gas that is expected to be recovered from the California OCS sale number 35, .75 to 7.78 trillion Btu's per day of synthetic oil and synthetic natural gas would have to be produced. If this entire amount were substituted with synthetic oil, 128,500 to 1,341,550 barrels a day would be required. Complete substitution by coal gasification would involve .722 to 7.54 billion cubic feet per day. This could necessitate the construction of 4 to 38 coal gasification plants with a capacity of 250 billion Btu's per day. The coal needed to operate these plants would be 18 to 190 million tons of coal per year. The estimated capital outlay would be $800 million for each gasification plant, the total for the 4 to 38 plants would, therefore, be $3.2 to $30. billion. SNG production projections are uncertain because of the present lack of a commercial synthetic gas industry and the uncertainty of the related economies and technology.

On January 17, 1975, a $200 million dollar contract was awarded by the Interior Department, Office of Coal Research, to Coalcon Company, New York, for production of 3,900 barrels/day of liquid and 22m cubic feet/day synthetic natural gas. Leading energy companies and agencies in Ohio and West Virginia will participate in the program, the first of its kind in the United States. (OCR News Release 1/21/75)

The gross comparison involved in the above analysis is somewhat misleading because perfect substitutability between synthetic gas and oil production and OCS production is implicitly assumed. The difference in longevity between a producing OCS field and a coal gasification plant invalidates this assumption. Though the California sale may result in the daily production of .75 - 7.78 trillion Btu's per day for forty years, the coal gasification plants proposed as alternatives may be operational for 75-100 years.

a. Coal Gasification - Description. Coal gasification is accomplished by reacting solid coal with steam, oxygen, air, hydrogen, or mixtures of these gases, to produce first a raw gas containing methane, carbon monoxide, hydrogen, carbon dioxide, steam, hydrogen sulfide, and ammonia in varying proportions depending upon the process. This raw gas is then processed to reduce or enhance certain of these constituents in order to prevent environmental pollution and to produce the type of gas needed for a particular use.

Gaseous fuels with low, intermediate, or high energy content can be produced. Low and intermediate gases are produced in a two-state process involving preparation and gasification; a third process, upgrading, is required to produce high-Btu gas.

Among low-Btu gasification processes under development are: Lurgi, Koppers-Totzek (both in commercial use), Bureau of Mines Stirred Fixed Bed, and Westinghouse Fluidized Bed. Among high-Btu gasification processes are: Lurgi high-Btu gasification process, HYGAS, BI-Gas, Synthane, CO_2 Acceptor.

b. Coal Gasification - Environmental Impact. The environmental impacts from coal gasification include those of mining which have been previously mentioned plus those resulting from the production processes. The impacts from mining, should gasification replace the production expected from this sale, will be of greater magnitude than those resulting from direct replacement of the projected OCS reserves by coal. This arises from the lower primary efficiency of the gasification processes: marginally more coal will have to be gasified to reach an equivalent Btu output. The impacts of processing can range over the whole spectrum. Water impacts can be minimized by recycling and evaporation. However, large inputs of water are required for some of the technologies, thus creating the potential for conflicts in water-short areas. For example, a Koppers-Totzek gasifier producing 250 x 10^9 Btu per day will require water in the amount of 463,000 gallons per day and coal in the amount of 10,750 tons per day. From 4 - 38 such plants would be necessary to replace the expected peak production from sale #35. Total annual water requirements would from .67 - 6.5 x 10^9 gallons, and coal requirements would be 18 - 190 x 10^6 tons.

Air pollution could include sulphur dioxide, particulates, nitrous oxides, hydrocarbons, and carbon monoxides. For the 38 Koppers-Tetzek plants described above, SO_x emissions could annually range from 67 - 152 x 10^3 tons, depending on the sulphur content of the input coal and the absence of pollution controls.

Land impacts result from solid waste disposal plus the land use for plant, coal storage, cooling ponds, etc. The solid waste generated annually by the 38 plants described above would range from 13 - 31 x 10^6 tons. This figure includes only ash from combustion. Other possible solids include sulphur and minute quantities of some radioactive isotopes. The land use of the 38 processing facilities would be 20 square miles, based on 330 acres per plant.

Coal Liquefaction - Description. As with coal gasification, production of liquid fuels from coal requires either addition of hydrogen or removal of carbon from the compounds in the coal. Coal liquefaction can be viewed as a change in the carbon to hydrogen ratio that can be accomplished by one of three reactions: hydrogenation, pyrolysis, or catalytic conversion. Of these, only the last is in commercial operation. Among liquefaction processes under development are: Synthoil, H-Coal, Solvent Refined Coal, Consol Synthetic Fuel, COED, TOSCOAL, and Fischer-Tropsch.

Coal Liquefaction - Environmental Impact. Again, the impacts of liquefaction will be those of mining, previously described, and those of the processing plants. The available technologies have a recovery of from .5 - 1.3 barrels of oil per ton of coal processed. Assuming plants of a 1 barrel per ton efficiency, yearly requirements of coal and cooling water will be about 47 - 490 x 10^6 tons and .33 - 3.42 x 10^6 acre-feet respectively. It should be noted that both these will vary with respect to the technology used.

Approximately 56 plants of 24,000 barrels per day would be needed to replace the maximum expected production from the proposed California lease sale.

The impacts of the processing plants have their effects on land, air, and water. Total annual water effluent from the plants would be approximately 792 x 10^6 gallons. This could contain amounts of phenols, solids, oil, ammonia, phosphates, and others. The waste water can be treated to remove most of these, given the proper incentives.

Air pollution could result from particulates, nitrous and sulphorous oxide, and others. Uncontrolled particulate from these plants could be 33,376 tons and nitrous oxides could be 342,894 tons annually. Sulphur dioxide emissions are a function of the sulphur content of the input coal and could reach from 22,500 - 140,000 tons per year. Pollution control facilities would be required, with their consequent detrimental effects on the economic feasibility of the plants.

Solid wastes, consisting mostly of ash, would be approximately 32 - 53 x 10^6 tons per year. It is assumed that liquefaction plants will be sited at the mine mouth, so this residue can be buried in the mine with little further environmental impact.

Land use for the 56 facilities will be about 44 square miles.

5. Oil Shale

a. Resource Base. Large areas of the United States are known to contain oil shale deposits, but those in the Green River formation in Colorado, Wyoming, and Utah are of the greatest potential for production. The Green River formation contains about 90 percent of the identified oil shale resources of the U.S. (University of Oklahoma, 1975)

The National Petroleum Council (1972) classifies oil shale resources based on commercial attractiveness:

Class 1 and 2.	The most accessible and better defined of the deposits at least 30 feet thick and averaging 30 gallons of oil per ton of shale. Class 1 averages 35 gallons per ton over a continuous interval of at least 30 feet.
Class 3.	Deposits as rich as Classes 1 and 2 but more poorly defined and not as favorably located.
Class 4.	Low grade, poorly defined deposits.

The synthetic oil necessary to replace the estimated production (273.8 to 2839.7 x 10^{12} BTU annually) from the California OCS sale would be 46.9 to 489.7 x 10^6 barrels, assuming equal BTU's per barrel. With high grade shale recovery of .71 barrels per ton, this would necessitate the mining of 66 to 689.7 x 10^6 tons of oil shale per year.

b. Environmental Impacts. Oil shale development poses serious environmental problems. With surface or conventional underground mining, it is very difficult to dispose of the huge quantities of spent shale, which occupy a larger volume than before the oil was extracted. Inducing revegetation in an area of oil shale development is difficult and may take more than ten years. In-place processing avoids many of these environmental hazards.

The land affected by the extractions and waste disposal for this size operation will average from 1,650 to 17,050 acres per year. For underground mining methods, there will be considerably less of an impact, since spent shale disposal will be the primary problem.

Air pollutants from the mining will come from dust and vehicular traffic. These will be minimal, and will probably be in the range of 200 to 2,000 tons per year. These will be predominantly particulates, followed by NOx and CO, with minimal amounts of hydrocarbons, SOx, and Aldehyde.

Mining requires little water, both for operations and for reclaiming solid wastes.

Water pollutants are considered negligible. The only problems would arise if saline water were encountered during the operations and had to be disposed of.

For preparation, (crushing the shale to a manageable size for processing), a crushing operation, with storage facilities, would require from about 50 to 250 acres.

Air pollution would arise from dust generated by the crushing operation and would total from about 250 to 2,400 tons annually.

Water pollution is expected to be minimal, as there is little water use in this stage of the operations, and it can be recycled fairly easily.

The solid wastes, mostly from dust control devices and spillage would total from about 0.5 to 5.0 x 10^6 tons annually. This can be disposed of by backfilling or other means.

The processing (retorting) operations consume large quantities of water and generate large amounts of waste water. The waste water must be treated and can be reused in the processes. Therefore, it has been assumed that water pollution will not be a problem outside the complex. However, the limited availability of input water in that area could lead to resource use conflicts.

Air pollutants vary with the technology used. For the Bumines in situ retorting process, the annual amounts could reach from 1,000 to 17,000 tons of particulates, etc., 0.7 to 7.5 x 10^5 tons, SOx and 3,000 to 31,000 tons hydrocarbons. This is the uncontrolled case. Other processes reuse the gases produced for power, so air pollution resulting from them will be significantly lower. Solid waste comprises the greatest problem of oil shale processing. The volume of the waste is greater than the volume of the input. Therefore, backfilling and the like would not provide a sufficient disposal space. More area is needed. The fixed land use for the retorting operations would be from about 25 to 250 acres.

This is in addition to the land use impacts of the mining, crushing, and disposal operations, so it can be seen that the oil shale alternative can have extremely disruptive effects on the local geo-, hydro-, and ecosystems. Finally, there are the impacts of access and of transporting the products. These are analogous to those of coal mining in the case of access, and petroleum distribution in the case of transporting the product.

6. Nuclear Power

a. Description

The predominant nuclear system used in the U.S. is the uranium dioxide fueled, light water moderated and cooled nuclear power plant. Research and development is being directed toward other types of reactors, notably the breeder reactor and fusion reactors.

Installed nuclear capacity as of June 1974 was 28,000 MW. At that time, nuclear power generated about 6 percent of the Nation's electricity. However, about half of the electric power capacity now under construction is nuclear powered. Nuclear power development has encountered delays in licensing and siting, environmental constraints, and manufacturing and technical problems. Furture capacity will be influenced by the availability of plant sites, plant licensing considerations, environmental factors, nuclear fuel costs, rate of development of the breeder and fusion reactors, and captial costs. In order to meet future uranium requirements, an increase in exploratory drilling activity will be necessary.

The nuclear capacity required to generate electricity to substitute for OCS sale production is shown below for two cases:

1. All of the OCS oil and gas were used to generate electricity.
2. All of the OCS oil and gas were devoted directly to end uses such as oil and gas heating.

Nuclear capacity required to substitute for the electricity which could be generated by the projected oil and gas from sale #35 would be 5 to 58 1,000-MW plants.

Capacity required to substitute for end uses would be 9 to 94 1,000-MW plants. The required amounts of nuclear fuel are shown below for both cases, assuming model 1,000-MW light water reactors.*

	5 to 58.1 1,000-MW Light Water Reactors	9 to 94 1,000-MW Light Water Reactors
A. tons U_3O_8 first core fuels - first year only 1/	2,900 - 33,640	5,248 - 54,520
b. thousands of tons of uranium ore required for a. 2/	1,450 - 16,800	2,623 - 27,205

* A limitation of this comparison should be noted. By noted. By asserting that a certain number of nuclear generators are required to replace OCS sale #35, perfect substitutability between a fixed plant, the nuclear generators, and a depletable resource, the OCS hydrocarbon base, is assumed. The comparison is therefore not perfect. This can be most readily seen by noting the discrepancy between the life expectancy of an OCS oil field (15-20 years) versus the much higher average lifetime of a nuclear generator.

1/ Assuming 80 percent plant factor.

2/ Assuming 0.20 percent average ore grade.

		5 to 58 1,000-MW Light Water Reactors	9 to 94 1,000-MW Light Water Reactors
c.	tons U_3O_8 annual reloads without plutonium recycling	1,000 - 11,592	1,810 - 18,768
d.	thousands of tons of uranium ore required for c.	459 - 5,796	904 - 9,384
e.	tons U_3O_8 annual reload with plutonium recycling	875 - 10,143	1,583 - 16,422
f.	thousands of tons of uranium ore required for e.	410 - 5,070	791 - 8,211
g.	acres of land required for sites 1/	8,500 - 97,000 8,500 - 97,000	15,000 - 157,000 15,000 - 157,000
h.	thousands of gallons of radioactive wastes produced yearly	45 - 521	81 - 845

b. Environmental Impacts

Although nuclear plants do not emit particulates or gaseous pollutants from combustion, serious environmental problems may arise. Some radioactivity in the form of radiation, airborne radioactivity, and radioactive liquids, is released to the environment. Although the amount released is very small and potential exposure has been shown to be less than the average level of natural radiation exposure, special precautions are required to control these emissions. The possible release of radioactivity as a result of an accident must

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1/ Assuming an average of 1,500 acres per 1,000-MW unit for cooling ponds and 500 acres per site containing three 1,000-NW units.

be anticipated in the design of the plant and its emergency systems. Malfunction of the emergency core cooling system has been of particular concern.

Nuclear plants use essentially the same cooling process as fossil-fuel plants and thus share the problem of heat dissipation from cooling water. However, light-water reactors require larger amounts of cooling water and discharge greater amounts of waste heat to the water than comparably sized fossil-fuel plants. The effects of thermal discharges may be beneficial in some cases. Adverse effects can be mitigated by use of cooling ponds.

Low level radioactive wastes from normal operation of a nuclear plant must be collected, placed in protective containees, and shipped to an AEC storage site and buried. High level wastes created within the fuel elements remain there until the fuel is spent. They are then isolated in a fuel reprocessing plant and stored in lequid or solid form at AEC facilities.

Furthermore, there are the impacts arising from the mining, processing and transportation of uranium ores and fuels.

The mining impacts are analagous to those for both surface and underground coal mining, plus the problems resulting from the radioactive nature of the material. For surface mining, these include suspended solids in wastewater, which can be handled by setting ponds; and radon gas, which is diluted in the atmosphere and has a short half-life.

For underground mines, the radon gas is of mine concern. The EPA is establishing exposure limits for miners, and its presence necessitates special ventilation in the mine.

The impacts are of smaller magnitude than those of coal mining due to the smaller amounts needed for an equivalent energy content.

The impacts of processing the ores involve solid and liquid waste disposal. For each 1,000 MWE LWR, the annual wastes will be 91,000 Metric tons of solids and 240,000 tons of liquids. These have low level emissions (2-24% of ERDA standards) and present no know health problems. The further steps, conversion of the U_3O_8 to UF_6 and enrichment also have effluents which are well below the ERDA standards. A fuller discussion of the impacts and economics of Uranium mining and processing can be found in the report: "Energy Alternatives: A Comparative Analysis" by the Science and Public Policy Program of the University of Oklahoma.

7. Solar Energy

Energy from the sun can be used to heat or cool individual buildings and to generate electricity. In the 1940's and 1950's, prior to the availability of low cost natural gas, firms selling solar water heaters did a booming business in California and Florida. Commercially installed solar heating and cooling in homes will be in use in many parts of the nation by 1985 and will be common by 1993. Moreover, intensifying current research and development could hasten these dates by five years (Morrow, 1973). Solar energy will eventually supply 35 to 50 percent of the nearly 20 percent of the nation's energy that is now devoted to space conditioning, thus reducing significantly the peak electricity demands of the summer months.

Applications of solar energy must take into account the following:

(a) Solar energy is a diffuse, low intensity source.

(b) Its intensity is continuously variable with time of day, weather, and season.

(c) Its availability differs widely between geographic areas.

Potential applications of solar energy show a wide range. Among them are:

Thermal energy for buildings
  Water heating, space heating, space cooling, combined systems
Renewable clean fuel sources
  Combustion of organic matter
  Bioconversion of organic materials to methane

Pyrolysis of organic materials to gas, liquid, and solid fuels

Chemical reduction of organic materials to oil

Electric power generation

Thermal conversion

Photovoltaic - residential/commercial, ground central station, space central station

Wind energy conversion

Ocean thermal difference

Because of the energy situation, congressional interest in solar energy research has intensified. The Solar Heating and Cooling Demonstration Act of 1974 legislates a $60 million demonstration program aimed at proving the commercial feasibility of solar $5,000-$6,000 (including costs of a standby conventional furnace) compared to $1,000-$2,000 for a conventional fossil-fuel home heating unit. However, the rising cost of the gas and oil needed by the conventional heaters means that the initial difference in fixed costs will quickly be overshadowed by the solar systems' lack of fuel costs. Therefore, though more costly at first, the solar unit will be the economical alternative over time.

Additionally, technological change could reduce cost. For instance, one demonstrated direct use of solar energy to heat and cool individual buildings appears to be very successful according to a recently completed study. This study called "Research Evaluation of a System of Natural Air Conditioning" was completed by a professional group from California Polytechnic State University under contract to the Department of Housing and Urban Development (Contract No. H2026R). In part this report states:

> "Results have shown that this system with minor modifications discovered by this evaluation, is workable from an architectural, a thermal, an economic, and occupancy standpoint at the present time, and that this system could play an important role in energy conservation in the United States without further prototype development."

What is particularly significant about this scientific report is that it was completed on an occupied California home (Atascadero). It needed no backup system and further more used no oil, gas, or electricity for heating or cooling throughout a year in which outside temperatures ranged from 26° to 99° F. During this period the report states that the indoor temperature at the five foot level cycled less than 4° F daily and the system (Skytherm) 1/ was able to keep the indoor temperature between the extremes of 66° F. and 74° F except during special test periods or times of prototype breakdown.

1/ "Skytherm" Systems were invented and patented by Harold R. Hay of Los Angeles, California.

Another excerpt from this report states:

> "Assuming that the system can be built with no premium, a 1,500 sq. ft. house costing $30,000 on a $6,000 lot carrying an 8 percent mortgage of $28,000 on which $20.00/month of utility cost saved is applied as additional payment, would have its loan period reduced from 25 to 19.7 years with an interest saving of about $13,600. If a $30/month utility reinvestment is made possible, the interest saving is about $17,500.

With this system's "zero" energy consumption, compared to conventional heating and cooling costs, it is appropriate to calculate the saving in fuel consumption at the point of electricity generation. Production of one KWHR of electricity requires about 13,656 BTU (assuming a 25% rate of efficiency in production and transmission). If one barrel of fuel oil (42 gallons) can produce 6,250,000 BTU then Skytherm in Atascadero is conserving approximately 20 barrels of fuel for annual heating and approximately an additional 10 barrels of fuel for cooling equalling an annual total saving of about 30 barrels.

The faster solar-conditioned houses are added to the housing inventory the greater their impact on the total energy consumption for the United States. If, for instance, over a period of 40 years, Skytherm type houses are built at an average rate of 50,000 units per year, the 2 million units will represent 2% of a 100 million total at the end of that period. To the extent that residential use continues to represent about 40% of the national energy consumption, the saving attributable to these type houses would be .8% of the national total.

In terms of air pollution, a saving of 1,500,000 1/ barrels (63,000,000 gallons) annually, would cause the following reductions in air contaminants 2/:

Carbon monoxide	252,000 lbs. ann.
(4 lbs. per 1,000 gallons)	
Hydrocarbons	189,000 lbs. ann.
(3 lbs. per 1,000 gallons)	
Particulate matter	1,449,000 lbs. ann.
(23 lbs per 1,000 gallons)	
Oxides of nitrogen	3,780,000 lbs. ann
(60 lbs. per 1,000 gallons)	
Sulphur dioxide	9,891,000 lbs. ann.
(157 lbs. per 1000 gallons) 3/."	

Presently this system has only been proved (according to the report) for the Southwest but other "Skytherm" Systems have been conceived for other climates and are in the early development stages.

1/ Assuming one years construction of 50,000 homes at a savings of 30 barrels per year.

2/ The reductions vary according to the grade of fuel being burned.

3/ This amount may vary according to the sulphur content of the fuel being burned.

Other new developments have been undertaken in the State of Colorado with rapid growth in Solar homes and office buildings. On the outskirts of Colorado Springs a 30 million dollar hospital complex is being built and will have a 1 million dollar solar heating system. The initial outlay is high but a city official feels that the savings in fuel over a six year period should pay for the system. 1/ The city is also requesting Federal financial assistance to install a single central bank of solar collectors to heat 54 low income homes. 1/

The full potential of solar energy can be realized only after large-scale generation of electricity using solar energy becomes technically and economically feasible. In this regard the Ford Administration has requested $33 million for solar electric programs in fiscal 1975 - almost $26 million more than the fiscal 1974 appropriation. A number of technical and engineering problems now prevent commercialization of solar steam-electric plants though pilot projects are well underway. It is estimated that solar electricity will be available on a significant scale in 10-15 years. (As a comparison, peak production from the intended OCS sale #35 will occur eight years after leases have been issued.)

1/ U.S. News and World Report, June 2, 1975.

Solar-electric energy does have a few disadvantageous aspects--high capital costs, expensive maintenance of solar collectors, thermal waste disposal, and distortion of local thermal balances being the most prominent.

The accelerating real costs of fossil-fuel will continue to increase the attractiveness of the solar energy option. In addition, the environmental impacts of solar energy are relatively less severe than those imposed by the traditional energy sources.

Solar energy cannot substitute for petroleum in all uses, transportation and petrochemicals being the most evident examples. However, as solar energy is used with increasing frequency for heating and electricity generation, oil and gas supplies previously devoted to heating and electricity will be channelled to the petrochemical and transportation industries and other exclusive uses of oil and gas.

8. Energy Imports

a. Oil

Increasing U.S. reliance on foreign energy supplies is another alternative to the proposed offshore California sale. U.S. imports of petroleum in 1974 amounted to 2.222 billion barrels. If oil from foreign sources were to replace the hydrocarbons expected from the subject sale, then an additional 123 to 220 million barrels would have to be imported during the peak production years. at 1974 world oil prices, this would entail a $1.3 to $2.3 billion increase in our oil import bill.

Studies conducted by the Department of the Interior show that oil produced on the OCS of the United States is much cheaper than the foreign alternative. Extraction plus transportation costs for OCS oil are anywhere from $6.50 to $8.00 per barrel which is less than the world oil price of approximately $11.00 per barrel.

The Project Independence study concluded that oil import levels will rise or at least remain the same in the next few years, no matter what long term actions the U.S. takes. Projected oil imports under the different strategies studied are shown below.

1985 U.S. Oil Imports

	World Oil Price $7 (MMBD)	$11 (MMBD)
Base case w/ and w/o emergency programs	12.4	3.3
Accelerated supply	8.5	0
Conservation	9.8	1.2
Accelerated supply plus conservation	5.6	0

Source: Federal Energy Administration, Project Independence Report, November 1974, p. 34.

For the base case, total 1985 oil imports at $7 world oil prices are estimated at 12.4 million b/d. Of these, 6.2 million would be susceptible to disruption. At $11 world oil prices, 1985 imports for the base case are estimated at 3.3 million barrels a day, of which 1.2 million would be subject to disruption.

Canada, the second largest supplier of U.S. crude imports, has adopted a policy of gradual phasing out of all crude exports to the U.S., possibly by 1983. As of January 1, 1975, the level of allowable exports to the U.S. was lowered to 800,000 b/d, and Canada is considering a further reduction. U.S. oil imports from Canada peaked at about 1.2 million b/d in 1973, and ran from about 760,000 to 900,000 b/d in late 1974. Actual crude exports to the U.S. in the last three months of 1974 were less than the new allowable level.

Total U.S. crude oil imports, on a four week average for December 1974, were slightly over 4 million b/d, compared with 3.04 million b/d for a comparable period in 1973. Oil imports have contributed to U.S. balance of payments problems.

Among the adverse environmental impacts of importing oil are possible spills from tankers carrying imported oil. Spills can result from intentional discharges accidental discharges, tanker casualties, and tanker collisions. A study of oil pollution in domestic waters during 1969-70 showed that tankers accounted for about 28% of the polluting oil. Results from that study are presented below.

ESTIMATED ANNUAL OIL POLLUTION OF THE OCEANS [a]

MARINE OPERATIONS	METRIC TONS	PERCENT
Tankers		
LOT tank cleaning operations	265,000	5.41
Non-LOT tank cleaning operations	702,000	14.34
Discharge due to bilge pumping, leaks and bunkering spills	100,000	2.04
Vessel casualties	250,000	5.11
Terminal operations	70,000	1.42
Tank Barges		
Discharge due to leaks	20,000	0.41
Barge casualties	32,000	0.65
Terminal operations	18,000	0.38
All Other Vessels		
Discharge due to bilge pumping, leaks and bunkering spills	600,000	12.25
Vessel casualties	250,000	5.11
Offshore Operations		
NONMARINE OPERATIONS		
Refineries and Petrochemical plants	300,000	6.12
Industrial Machinery	750,000	15.31
Highway Motor Vehicles	1,440,000	29.41
TOTAL	4,897,000	100.0

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[a] The final total does not include oil contributed by recreational boats, hydrocarbon fallout, and natural seepage.

Source: Tankers and the U.S. Energy Situation - an Economic and Environmental Analysis. Joseph D. Porricelli and Virgil F. Keith.

Energy Imports

b. Natural Gas

Pipeline imports of natural gas into the U.S. have come mainly from Canada and Mexico. However, significant expansion of natural gas imports from these countries is questionable because of increasing domestic demand, both current and future, within Canada and Mexico. Canada's intention to gradually phase out all crude oil exports to the U.S. creates uncertainty regarding future natural gas exports to the U.S.

The growing shortage of domestic gas has encouraged projects to import liquefied natural gas (LNG) under long term contract. Large scale shipping of LNG is a relatively new industry and the U.S. does not yet have facilities for receiving base load shipments. Several LNG projects are now under consideration on the Pacific, Atlantic, and Gulf coasts. However, the Middle East oil cutback has raised questions concerning the security of foreign, especially Algerian, sources of LNG. The complexity of and length of time involved in implementing these proposals has been increased by the need for negotiating preliminary contracts, securing the approval of the Federal Power Commission and the exporting country, and making adequate provision for environmental and safety concerns in the proposed U.S. facilities.

Natural gas imports of .73 to 7.54 billion cubic feet a day (266 to 2754 billion cubic feet a year) would be required to replace the total energy expected from the sale. In view of Canadian policy of phasing out crude exports and limiting future energy exports in order to meet anticipated increases in domestic demand, it is doubtful that any more gas would be available for import by pipeline.

LNG import levels will depend on how soon this industry can be introduced into the U.S. The question of security of foreign LNG supplies has caused re-evaluation of these projects.

The environmental impacts of LNG imports arise from tankers; terminal, transfer, and regasification facilities; and transportation of the gas. The primary hazard of handling LNG is the possibility of a fire or explosion during transportation, transfer, or storage.

Receiving and regasification facilities will require prime shoreline locations and possible dredging of channels. Regasification of LNG will release few pollutants to the air or water.

LNG imports will influence the U.S. balance of payments. This impact will depend on the origin and purchase price of the LNG, the source of the capital, and the country (U.S. or foreign) in which equipment is purchased and LNG tankers are built.

9. Geothermal Energy.

Geothermal energy is primarily heat energy from the interior of the earth. It may be generated by radioactive decay of elements such as uranium or thorium, and friction due to tidal or crustal plate motions.

There are four major types of geothermal systems: hot water, vapor dominated, geopressured reservoirs, and hot dry rock systems. The most commercially attractive, although relatively rare, are the vapor dominated systems, such as the Geysers field. To date, no production has come from geopressured or hot dry rock reservoirs.

Geothermal plants are smaller than conventional plants and require a greater amount of steam to generate the same amount of electricity. This is due to the fact that temperatures and pressures associated with geothermal areas are lower than those created at conventional powerplants.

The greatest potential for geothermal energy in the U.S. is in the Rocky Mountain and Pacific regions; some potential exists in the Gulf Coastal Plain of Texas and Louisiana. Limited geothermal exploration to date has resulted in widely varying estimates of geothermal reserves.

The Geysers Field in California is the most extensively developed source of geothermal energy in the U.S. It has been producing power since the 1960's. Exploration efforts are underway in the Imperial Valley, Salton Sea, Mono Lake, and Modoc County, California. Within twenty years, geothermal energy may account for about 1 to 2% of total U.S. energy and about 5% of California's total energy consumption. All locations likely to be developed by 1985, and probably 2000, are in the western third of the country.

Environmental Impacts.

A number of gases are associated with geothermal systems and may pose health and pollution problems. These gases include ammonia, boric acid, carbon dioxide, carbon monoxide, hydrogen sulfide, and others. As an illustration, air emissions at the Geysers plant are shown below.*

	Quantity for a 1,000 Mwe plant (per year)
Water (million gallons)	15,800
Waste heat (billion kwh)	44.9
Carbon dioxide (tons)	631,732
Ammonia (tons)	54,000
Methane (tons)	40,020
Hydrogen sulfide (tons)	39,249
Nitrogen, argon (tons)	24,034
Hydrogen (tons)	7,993

* Emissions from cooling tower and steam gas ejectors.
Source: Energy Alternatives, A Comparative Analysis, p. 8-23.

However, adverse air quality impacts are generally less than those associated with fossil-fuel plants. Also related to geothermal energy systems are saline waters which must be disposed of and isolated from contact with ground water regimes.

Land quality problems stem from disturbance due to construction of related facilities, and possible ground subsidence, which in turn can cause structural failures and loss of ground water storage capacity.

10. Hydroelectric Power

a. Description

The energy captured from alling water is termed hydropower. This falling water, regulated and controlled by human technology, is used to drive turbines and thus produce electrical energy. The engineering problems in converting hydropower to electrical energy were mastered early and many of the major hydroelectric sites operating today were developed in the early 1950's. The Pacific Northwest region and California are served by hydroelectric power to a greater extent than most other regions of the nation because of the wet climate and favorable topography.

Theoretically, increased domestic reliance on hydropower is currently possible. The undeveloped potential for hydroelectric generation in the lower 48 States alone is about 93,000 MW (FPC. 1972). If that potential were developed fully then hydropower could supply nearly 8% of the current domestic energy demand, (FPC, 1972). Yet most energy supply forecasts envision a relative decline in hydropower's future contribution to domestic energy needs. This paradox stems from the f following conditions:

1. The sites with the greatest productive capacity and the lowest development costs have already been exploited.
2. Hydroelectric power imposes substantial land use conflicts and environmental side-effects.
3. The dams and reservoirs required by hydropower development have very high capital costs.
4. The amount of energy that can be produced via hydropower varies with the seasons.

5. Manipulation of reservoir storage capacity is constrained by water use and flood control considerations.

In consequence of the above factors, an important future application of hydropower in California, and across the entire Nation, will be "pumped storage" hydroelectric projects. Pumped storage uses the excess energy generated by nuclear fossil fuel plants to pump water from a lower reservoir to a higher one. During periods of peak electricity use, the previously pumped water is allowed to fall from the upper reservoir through a generating unit to the lower reservoir thus producing the electricity required during the period of elevated demand. Pumped storage has at least 2 advantages:

1. It optionally utilizes the excess energy of conventional electricity plants and thus improves their efficiency.
2. It makes available the most economical supply of peak quantities of electricity during periods of accelerated demand.

The quantity of hydroelectric energy needed to substitute for the oil and gas expected from the proposed California sale #35 depends on whether the oil and gas is used directly for purposes such as heating or if it is burned to produce electricity, and indirect use. Since direct use is more efficient, substitution in this instance would require a larger quantity of hydroelectric energy versus the case where oil and gas were burned to produce electricity.

To substitute for end uses, 8.8 - 93.5 thousand megawatts per day of hydroelectric energy would be needed. To substitute for the electricity which could be generated by the oil and gas, 5.4 - 57.6 thousand megawatts of capacity would be needed.

Several constraints limit future hydropower development and its feasibility as an alternative to fossil fuels. Hydropower cannot be substituted for oil and gas in transportation uses or in industrial uses that depend on the unique properties of oil and gas. Land use priorities may inhibit development of the few potential hydro-sites east of the Mountain states. Furthermore, few dams are built solely for hydroelectric power generation. Irrigation, navigation, municipal and industrial uses, and flood control are frequently more important than and not fully compatible with power production needs. Since hydropower is most often used to service peak loads, other energy sources must be relied on for base power loads.

b. Environmental Impact

Construction of a hydorelectric dam represents an irreversible commitment of the land resources beneath the dam and lake. Flooding eliminates wildlife habitat and prevents other uses such as agriculture, minging, and free-flowing river recreation.

Hydroelectric projects do not consume fuel and do not cause air pollution. However, use of streams for power may displace recreational and other uses. Water released from reservoirs during summer months may change ambient water temperature and lower the oxygen content of the river downstream, adversely affecting indigenous fish. Fluctuating reservoir releases during peak load operation may also adversely affect fisheries and downstream recreation.

Fish may die if exposed to nitrogen supersaturated water. Nitrogen supersaturation results at a dam when excess water escapes from the draining reservoir. High nitrogen levels in the Columbia and Snake River pose a threat to the salmon and steelhead resource of these rivers.

11. Other Energy Sources

The high costs and rapidly shrinking reserves of the traditional energy fuels have encouraged research into new and different sources for potential energy. As the traditional fuels continue to exhibit accelerating rates of cost growth, demand for and eventual substitution of alternate energy forms will occur. Some of these alternate sources have been known for decades but high costs and technical programs have prevented their widespread use.

Environmental impacts of these alternatives are sometimes difficult to assess, especially if a great amount of research and development remains to be completed before operational scale systems can be developed, tested, and evaluated.

For the alternatives listed below, the date of commercial availability will depend on the cost of the traditional energy fuels, the level of Federally-subsidized research, and the probability of encountering insurmountable engineering and technical problems. Thus some of these energy sources could be installed within the current decade, while others may prove never to be feasible.

I. Possible significant energy contribution before 1985 1/

Energy forms	Primary Limitations	Secondary Limitations
Geothermal energy	Resources	Economics
Tar sands	Resources	Economics
Solar	Technology	Economics

II. Improbable significant contributions before 1985

Energy forms	Primary Limitations	Secondary Limitations
Hydrogen	Economics	Technology
Biological (agricultural & wastes)	Economics	Resources
Tidal	Resources	Economics
Wind	Resources	Economics
Energy Conversion Devices		
Fuel cells	Technology	Economics
Thermionics	Technology	Economics
Thermoelectric	Technology	Economics
Magnetohydrodynamics	Technology	Economics

1/ After: New Energy Forms Task Group 1971-1985, National Petroleum Council Committee on U.S. Energy Outlook, 1972.

Federal energy research and development funding has expanded significantly in the last few years. President Nixon announced in his Energy Message of January 23, 1974, that Federal commitment for direct energy research and development will be increased to $1.8 billion in FY 75. The table below shows the funds for different areas of research and the agencies involved.

Federal Energy R&D Funding
($ million)

Direct programs	FY74	FY75	Agency*
Conservation	65.0	128.6	
a. End use (residential & commercial)	15.0	27.9	DOI, other
b. Improved efficiency (transmission)	5.0	18.8	AEC, DOI, NSF
c. Improved efficiency (conversion)	14.9	29.8	AEC, DOI, NSF
d. Improved efficiency (storage)	2.9	6.4	AEC, NSF
e. Automotive	14.2	23.7	AEC,EPA,NSF,DOT, DOD,NASA
f. Other transportation	13.0	22.0	DOT,DOC
Oil, gas, and shale	19.1	41.8	
a. Production	3.0	17.0	DOI
b. Resource assessment	5.0	13.1	DOI,NSF
c. Oil shale	2.3	3.0	DOI
d. Related programs	8.8	8.7	AEC,DOI
Coal	164.4	415.5	
a. Mining	7.5	55.0	DOI
b. Mining, health, & safety	27.0	27.7	DOI
c. Direct combustion	15.9	36.2	DOI,NSF
d. Liquefaction	45.5	108.5	DOI,NSF
e. Gasification (high BTU)**	33.0	65.3	DOI,NSF,AEC
f. Gasification (low BTU)	21.3	50.7	DOI,NSF
g. Synthetic fuels pioneer prog.		42.1	DOI 1/
h. Resource assessment	1.2	1.9	DOI
i. Other (incl. common technology)	11.7	28.1	DOI

1/ This request was later reduced by $27.0 million.

Environmental control	65.5	178.5	
a. Near term SO_x	39.9	82.0	EPA, DOI
b. Advanced SO_x	4.0	12.0	EPA
c. Other fossil fuel pollutants (incl. NO_x, particulates)	13.1	57.0	EPA
d. Thermal pollution	1.5	18.5	EPA, AEC
e. Automotive emissions	7.0	9.0	EPA
Nuclear fission	530.5	724.7	AEC 1/
a. LMFBR	357.3	473.4	
b. Other breeders (GCFBR & MSBR)	4.0	11.0	
c. HTGR	13.8	41.0	
d. LWBR	29.0	21.4	
e. Reactor safety research	48.6	61.2	
f. Waste management	6.2	11.5	
g. Uranium enrichment	57.5	66.0	
h. Resource assessment	3.4	10.4	
i. Other (incl. advanced tech.)	10.7	28.8	
Nuclear fusion	101.1	168.6	AEC
a. CTR	57.0	102.3	
b. Laser***	44.1	66.3	
Other	53.5	157.5	
a. Solar	13.8	50.0	AEC, NSF
b. Geothermal	10.9	44.7	AEC, DOI, NSF
c. Systems studies	17.3	30.0	AEC, DOI, NSF, FEA, Treasury, FPC, other
d. Misc.	11.5	32.8	NSF, DOI
Support programs			
Environmental effects research	169.7	303.4	AEC, EPA, NSF
a. Pollutant characterization, measurement, & monitoring	16.3	37.4	
b. Transport of pollutants	26.6	55.6	
c. Health effects	72.6	112.5	
d. Ecological effects	27.3	65.0	
e. Social & welfare effects	17.5	19.8	
f. Environmental assessment & policy formulation	9.4	13.1	

1/ The AEC research budget was later increased by $40 million.

Basic research	94.5	174.6	AEC, NSF
a. Materials	13.2	32.9	
b. Chemical. physical. engineering	30.8	58.1	
c. Biological	40.3	60.5	
d. Plasmas	2.8	8.2	
e. Mathematical	7.4	14.9	
Manpower development	6.3	8.5	AEC, NSF
Total (direct energy R&D)	999.1	1,815.5	
Total (support programs)	270.5	486.5	
Total (direct & support)	1,269.6	2,302.0	

*Agency codes:
AEC - Atomic Energy Commission
DOC - Department of Commerce
DOD - Department of Defense
DOI - Department of the Interior
DOT - Department of Transportation
EPA - Environmental Protection Agency
FFA - Federal Energy Administration
FPC - Federal Power Commission
NASA - National Aeronautics and Space Administration
NSF - National Science Foundation

**Funds for high Btu gasification in the Office of Coal Research budget do not include Trust Fund amounts.

***Includes amounts for laser fusion directed toward military applications.

12. Combination of Alternatives.

The future U.S. energy source mix will depend on a multiplicity of factors, among them the identification of resources, research and development efforts, development of technology, rate of economic growth, the economic climate, changes in life-style and priorities, capital investment decisions, energy prices, world oil prices, environmental quality priorities, government policies, and availability of imports.

The Project Independence Report 1/ estimated U.S. energy demand and domestic supply for four cases. These data are shown below.

U.S. Energy Demand and Domestic Supply, 1985

World Oil Price	$7 per barrel		$11 per barrel	
	Demand (quads)	Domestic Supply (quads)	Demand (quads)	Domestic Supply (quads)*
Base case w/ and w/o emergency programs	109.1	84.2	102.9	96.3
Accelerated supply	109.6	92.6	104.2	104.2
Conservation	99.2	79.6	94.2	91.8
Accelerated supply plus conservation	99.7	88.5	96.3	96.3

*Quad - a quadrillion Btu's.

1/ The data cited in this section are taken from: Federal Energy Administration, Project Independence Report, November 1974.

The table below shows the breakdown of total domestic fuel supplies for the base case and the accelerated supply case.

Domestic Fuel Consumption by Source, 1985
(in quads)

	1972 Actual	$7 world oil Base Case	$7 world oil Acc Supply	$11 world oil Base Case	$11 world oil Acc Supply
Coal	12.5	19.9	17.7	22.9	20.7
Oil	22.4	23.1	30.5	31.3	38.0
Gas	22.1	23.9	24.7	24.8	25.5
Hydro and Geo	2.9	4.8	4.8	4.8	4.8
Nuclear	0.6	12.5	14.7	12.5	14.7
Synthetics					0.4
Imports	11.7	24.8	17.1	6.5	0
Total	72.1	109.1	109.6	102.9	104.2

The increases in domestic supply under the accelerated supply case are due largely to the following:

Standardization and expedited licensing to increase nuclear capacity 15% by 1985.

Significant new leasing, exploration and development of the Pacific, Gulf of Alaska, and Atlantic OCS.

Additional oil and gas pipelines from Alaska to the lower 48.

Increased Federal leasing and actions to allow additional oil shale production.

Opening Naval Petroleum Reserves #1 and #4 to full scale commercial development.

Possible mandatory allocation or other actions to assure critical materials and equipment to meet expected production levels.

For the base case, the Project Independence Report envisions the role of alternative energy sources as the following:

> Petroleum production is severely constrained in the short run and greatly affected by world oil prices in the long run. Before 1977 there is little that can prevent domestic production from declining or at best remaining constant.
>
> Coal production will increase significantly, but is limited by lack of markets. Increases are limited by rate of electric growth, increasing nuclear capacity, and environmental restrictions.
>
> Potential increases in natural gas production are limited.
>
> Nuclear power is expected to grow from 4.5% to 30% of total electric power generation.
>
> Synthetic fuels will not play a major role between now and 1985.
>
> Shale oil could reach 250,000 B/D by 1985 at $11 world oil prices, but would be lower if $7 prices prevail.
>
> Geothermal, solar, and other advanced technologies are large potential sources, but will not contribute to our energy supplies until after 1985.

In the interest of clarity of presentation, the previous sections have discussed separately each petential alternative form of energy as a possible substitute to the proposed sale. However, it is unlikely that there will ever be a single definitive choice between energy sources or that development of one source will preclude development of others. Different energy sources will differ in their rate of development and the extent of their contribution to U.S. energy supplies. Understanding of the extent to which they may replace or complement offshore oil and gas requires reference to the total national energy picture. Relevant factors are:

1. Historical relationships indicate that energy requirements will grow at approximately the same rate as gross national product.

2. Energy requirements can be constrained to some degree through the price mechanisms in a free market or by more direct constraints. One important type of direct constraint operating to reduce energy requirements is through the substitution of capital investment in lieu of energy; e.g., insulation to save fuel. Other potentials for lower energy use have more far-reaching impacts and may be long range in their implementation - they include rationing, altered transportation modes, and major changes in living conditions and life styles. Even severe constraints on energy use can be expected to only slow, not halt, the growth in energy requirements within the time frame of this statement.

3. Energy sources are not completely interchangeable. Solid fuels cannot be used directly in internal combustion engines for example. Fuel conversion potentials are severely limited in the short term although somewhat greater flexibility exists in the longer run and generally involves choices in energy-consuming capital goods.

The principal competitive interface between fuels is in electric powerplants. Moreover, the full range of flexibility in energy use is limited by environmental considerations.

4. A broad spectrum of research and development is being directed to energy conversion - more efficient nuclear reactors, coal gasification and liquefaction, liquified natural gas (LNG), and shale retorting, among others. Several of these should assume important roles in supplying future energy requirements, though their future competitive relationship is not yet predictable.

5. Major potentials for filling the supply/demand imbalance for domestic resources are:
   - More efficient use of energy
   - Environmentally acceptable systems which will permit production and use of larger volumes of domestic coals.
   - Accelerated exploration and development of all domestic oil and gas resources.
   - Development of the Nation's oil shale resources.

   Of the foregoing increased domestic oil and gas production offers considerable possibilities, although adequate incentives must exist for indicated and undiscovered domestic resources to be discovered and extracted.

6. The acceptability of oil and gas imports as an alternative is diminished by:
   - The security risks inherent in placing reliance for essential energy supplies on sources which have demonstrated themselves to be politically unstable and prone to use interruption of petroleum supplies to exert economic and political pressure on their customers.
   - The aggravation of unfavorable international trade and payments balances which would accompany substantial increases in oil and gas imports.
   - Apparent high costs of liquefying and transporting natural gas other than overland by pipeline.

SECTION VIII.B

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C. Delay Sale

1. Until New Technology is Available to Provide Increased Environmental Protection

If a decision is made to hold the proposed lease sale at a more distant future date, then advances in drilling technology and methodology would decrease the potential for a hazardous environmental impact. Advances in technology will not necessarily be proportional to the additional time gained through a delay in the proposed lease sale. That is, although large technological and methodology advances may be attained in a five year period, it may take the next ten years to make similar gains. Future gains whether large or small, will diminish the present environmental risk levels attendant to drilling and operations proportionately to the increase in technology and methodology.

The sale could be delayed until new technology for cleanup and control is available, however, the current technology is reliable within its capabilities (see Section IV.C.) being primarily limited by application, regulation and control. Prevention of accidents and proper design for no or minimal environmental impact is the most desirable policy. The majority of accidents or detrimental environmental impacts are caused by either human error or taking "short-cuts" and not using the best designs, equipment or techniques available. As the best technology cannot eliminate poor design or human error, there is little significant advantage that would be gained by waiting for the development of any new technology for cleanup and control equipment.

At the present time, there appears to be no new major technological developments that will be forthcoming in spill control and cleanup.

Offshore conditions remain highly dependent on the weather. Along the entire Southern California coastline, a wide range of modifiers, skimmers, barriers, storage devices and sorbents are available on short notice.

These can be obtained from private, cooperative, and Federal sources. Past experience has shown that the major limiting factor on effectiveness is the experience, judgement, and communications of the team using the equipment available. Offshore requirements in Southern California will require equipment that is available but not on hand and increased communication ability.

Considering the higher financial loss incurred by anyone accidently or deliberately discharging or causing to be released a harmful substance into the environment, all companies and agencies involved in this type of effort are initiating, on their own, measures to take advantage of the technology available.

As new technology relating to safety and environmental protection is developed, it can be incorporated with existing requirements and applied to all OCS leases by updating OCS orders or providing notices to lessees and operators if necessary.

2. Pending Completion of Studies Concerning the Potential Environmental Impacts of Offshore Minerals Development in General, and Oil Spills Specifically

With a delay in the proposed lease sale, more time will be acquired for research of the effects drilling and oil production activities have on the marine environment, and a more complete evaluation of the Borderland marine environment will be accomplished through baseline studies. The Bureau of Land Management is initiating long-term ongoing studies of its own, both on an inhouse and contract basis. See Section I.D. for a summary of the baseline studies.

Research studies can help science, industry and government to better understand detrimental aspects of drilling and oil operations which may be currently vaguely assumed, or have had only a small amount of research work completed in that field. Conversely, research results may dispel some environmental concerns which are currently raised.

Research projects may look into the long-term effects of drilling and oil operations on the environment. Such studies could be directed to specific items, such as drilling mud disposal and oil spill effect on the environment. These studies could cover the following potential environmental aspects: mutagenic effects, changes in reproductive rates, toxicological effects, accumulative pathways in the food chain, etc. The possible effects of chronic low-level exposure of the marine ecosystem to hydrocarbons may be resolved.

Information gathered from baseline work should be useful in delineating additional areas of biological signifcance. This data will help to reduce the data gaps that are present in the Borderland.

Through a better understanding of the marine geology in the Borderland, geologically hazardous areas and sites of potential mineral deposits can be better identified. Currently, the interactions of hydrocarbon lease activities with other OCS minerals of potential economic value are poorly analyzed. A delay would allow better analysis and planning which could result in compatability between what may otherwise be mutually exclusive resource developments.

As the recent University of Oklahoma study, "Energy Under the Oceans: A Technology Assessment of Outer Continental Shelf Oil and Gas Operations," points out, current and programmed research on OCS Environmental data will help improve our knowledge; however, acquiring a total functional understanding of the coastal environment is an "extremely long-term goal".

3. Pending Development of Land Use and Growth Plans Onshore

Through a delay in the proposed lease sale, land use plans for coastal areas, as they relate to potential offshore development, could be coordinated between the state of California and the Federal Government. Although more time may be devoted towards a better coordinated effort of land use planning, without more knowledge of the oil and gas deposits, planning solutions and premises may not be as accurate as possible. More knowledge of oil and gas deposits, as mentioned previously, can only be accomplished through exploratory drilling. However, the 2-3 year period of exploratory drilling before development takes place is adequate to allow completion of Coastal Commission hearings and adoption by the legislature of those coastal management policies which it chooses to pursue. Element 9 of the Coastal Plan requires that new or existing agencies be identified to carry out the Coastal Plan when the present Coastal Zone Conservation Commission reaches the end of its statutory existence this year (1975). Sufficient implementation time of element 9 would be available during the exploratory phase of development.

4. Pending Completed Implementation of Recommendations Made In Reports on OCS Operating Orders and Regulations and a Review of Regulations and Amendment as Necessary

By delaying the proposed lease sale, lease contract stipu-

Availability of results of research studies to identify significant adverse short term and/or long term impacts resulting from oil and gas operations.

Implementation of baseline and monitoring studies for a supply of information on the marine environment within and around the proposed lease area prior to commencement of operations which may initiate changes (2 years).

If the proposed lease sale were delayed 1-5 years the adverse impact would be:

Adverse environmental impacts of alternative energy resources.

Adverse economic impact on the Balance of Payments due to greater imports of foreign crude.

Delay of Project Independence's goals of energy selfsufficiency.

Development of other OCS areas in lieu of Southern California which would result in adverse environmental impact in these areas.

It is conceivable that the potential environmental impact of operations resulting from a sale held after such a delay would be of much the same character as those potential impacts discussed in relation to the sale as proposed, but the risk for such impacts could be reduced.

D. Alternative OCS Leasing Areas

The following section contains references to the detailed description and impact-producing discussion found in the final EIS for the proposed program to increase OCS leasing nationwide (Programmatic FEIS) for each of the various OCS areas of the United States which could support future oil and gas leasing. The timing and extent of potential offshore development in these areas is a function of many factors. Among these considerations are: offshore resource potential, environmental legal constraints, industry capability in developing the required OCS technology and meeting material and manpower needs, and the ability of onshore geographic areas to cope with increased industrial development of the coastal zone.

A proposed planning schedule of leasing areas for proposed OCS oil and gas lease sales was announced to the public in November 1974 and was developed after careful weighing of a number of resource, environmental, and technical factors. This schedule was revised in June 1975 to reflect changes in the timetables for considering certain sales listed on that schedule (see Appendix 3). It is the proposed policy of the Department of the Interior to consider leasing the most promising areas for oil and gas potential first, to the extent that the Department determines that environmental and technical considerations do not warrant delay in considering potential leasing of particular areas of promise. This approach has been adopted by the Department in light of the contribution that can be made by OCS oil and gas production in meeting domestic energy demand and is designed to ensure that relatively scarce capital, manpower, and equipment resources can be first employed on the most promising areas consistent with the protection of environmental values. The tentative schedule is a flexible planning document and does not represent a decision to lease in any of the particular areas identified therein.

Offshore oil and gas development causes certain common environmental impacts regardless of geographic location. Primary offshore impacts are related to accidental spills of oil and other toxic substances, discharge of drilling fluids and formation waters, pipeline burial, and OCS use conflicts. Onshore impacts result from the siting of processing and support facilities, socio-economic impacts of increased industrial activity and the potential beaching of spilled oil. In addition, other impacts can be predicted due to special environmental conditions that exist in a specific OCS area. Each of these unique impacts is descussed in detail under the appropriate impact section of the Programmatic FEIS as listed below. Also refer to Section III.H. of the Programmatic FEIS for a Resources Summary and Oil Spill Risk Summary for each of the considered OCS areas.

1. Atlantic Region
   Description of the Environment - Volume 1, Sections II.A.1., II.B.1., and II.C.1-3.

   Environmental Impacts - Volume 2, Sections III.C., E., F. and G.

2. Gulf of Mexico Region
   Description of the Environment - Volume 1, Sections II.A.2., II.B.2. and II.C.4-5.

   Environmental Impacts - Volume 2, Sections III.C.,E., F. and G.

3. Pacific Region
   Description of the Environment - Volume 1, Section II.A.3., II.B.3. and II.C.6-9.

   Environmental Impacts - Volume 2, Sections II.C., E., F. and G.

4. Alaska Region

Description of the Environment - Volume 1, Sections II.A.4., II.B.4. and II.C.10-15.

Environmental Impacts - Volume 2, Sections III.C., E., F. and G.

A discussion of unavoidable adverse environmental effects for each area is found in Volume 2, Section V.

E. Alternatives Within the Proposed Action

1. Government Exploratory Drilling Prior to Leasing

Exploratory drilling conducted by or sponsored by the Federal Government prior to holding a lease sale would be an alternative within the proposed action. This would involve an alternative approach to one aspect of the present Federal leasing system. Another alternative to the present leasing system is Government exploratory drilling before holding lease sales. At the present time there is little exploratory drilling on the OCS prior to leasing. The U.S. Geological Survey receives all engineering and geological data from companies who have drilled on leases issued on the OCS. These data and geophysical data purchased on the open market are used by the Geological Survey to develop OCS lease policies and evaluate tracts prior to leasing. For a complete discussion of this alternative see Section VIII.J. of the Final EIS for Proposed Increase on Oil and Gas Leasing in the Outer Continental Shelf.

2. State Participation in Development Decisions

Under current procedure, the proposed action provides for no formal state participation in the decision to issue the development permits required before OCS oil and gas deposits can be developed and produced. However, there are a number of alternatives available to the Secretary which could provide for state participation. One is to provide a suspension of operations between the exploration phase and the development phase during which affected states could review the proposed development. A second is to require lessees to provide appropriate information to affected states at the time the development plan is submitted.

a. Suspension Between Exploration Phase and Development Phase of Potential Lease Operations

An alternative within the proposed action which is available to the Secretary in connection with making a decision on the proposed action is to provide for a suspension of operations between the exploration and development phases of potential lease operations. This would allow for a more comprehensive review of plans of development than is provided for at the present time. Under this alternative potential lessees could be required to submit simultaneously to the Governor of California, or a state agency designated by the Governor, for purposes of review and comment, the plan of development required to be submitted to the Geological Survey.

State review at this stage may be beneficial where the plan involves onshore facilities, such as pipeline landings sites and onshore support facilities, the ultimate approval of which would be within the jurisdiction of the adjacent state. Any modification of an approved plan of development which requires federal approval could likewise be submitted for state review and comment.

Under the existing system of OCS lease supervision, only federal review of plans of development is provided for (30 CFR 250.34). State and local officials of California have expressed the view that under this system they may be forced to make hasty and ill-informed decisions regarding potential onshore facilities. Customary suspension between exploration and development stages may provide a more orderly and efficient procedure for federal and state decisions concerning those potential offshore and onshore aspects of OCS lease development within the exclusive or concurrent jurisdiction of the respective governments. Adoption of this procedure would generally result in a longer period of delay in initiating potential development operations.

Legal Requirements

If the Secretary should decide that a suspension of operations in the interest of conservation of natural resources, as contemplated by Section 5(a) of the OCS Lands Act (43 U.S.C. 1334(a)), would be justified, he could direct such a suspension to allow a review of the development plan and action upon it. An extension of the life of the lease for a period equal to the period of the suspension would then be directed. In order to give full notice to potential lessees, the Department should publish in the Notice of Sale a formal provision for inclusion in the lease authorizing a suspension following the exploration phase to permit proper review and comment. Although the lease provision should itself merely authorize the suspension, the Notice of Sale should indicate that the suspension for state review would be for a specified period, e.g., three months. For the suspension to be legally supportable, it must hold promise of the right of development at some future time. Involuntary termination of the lease, either by actual termination or by a suspension which has the effect of a termination, at the end of the exploratory phase, is not contemplated. If the Secretary, in certain circumstances, should decide that public interest requires termination of an OCS lease at the end of the exploratory phase, he can achieve this goal only by the enactment of special legislation. A further suspension to obtain such legislation would be justified for a limited period.

Time Period Provided for State Review and Comment

The suspension of operations could be for a period of three months to provide for review of and comment on a development plan by an adjacent state. This should provide time for comprehensive review and would not involve an undue delay between potential exploration and potential development.

Other time periods for state review are possible. If the Secretary adopted this alternative, he could decide to provide for a review and comment period of six months or longer. It is noted that, under the Coastal Zone Management Act of 1972 (16 U.S.C. 1451-1464), a period of six months is granted to a state with a federally-approved coastal zone management program to indicate whether or not it concurs with a certification by an applicant for a federal permit that a proposed activity is consistent with said program. While no such management program has yet been approved pursuant to that Act, it is possible that, if the proposed sale is held, California would have an approved program before potential development and production of oil and gas occurred within the proposed lease area. The Secretary could decide that, by analogy to that Act, a six-month period rather than three months for review and comment would be more desirable.

If the Secretary should decide to provide for a six-month period or longer for such review, there could be a longer period for state review of plans of development and a corresponding delay between potential exploration activities and potential development activities on any OCS leases which might be issued.

Timing of the Suspension Between Exploration and Development Phases

The point at which the exploratory phase would be considered completed, and further activities would require approval of a development plan, would occur at the time the mineral potential of the lease(s) has been delineated and evaluated. In the normal course several exploratory wells must be drilled, under a plan of exploration, before decisions could be made as to what type of production facilities should be constructed and where they should be located. This latter information would be included in the plan of development.

Area to be Covered by Plan of Development

If a tract is being operated as an individual lease, the development plan would cover the proposed operations on that lease. Where multiple tracts are being operated jointly, the development plan would cover the proposed operations on all tracts involved in the joint operations. In either case, all available information in a general area would be used in the review of the plan of development. This would allow for review of the plan in relation to operations being conducted on other leases in the general area, including such matters as availability of existing and proposed pipelines, onshore facilities, and availability and location of pollution containment and removal equipment in the area in question.

Plans of Development for Unitized Areas

If a determination were made to adopt this alternative, the Secretary could decide to require unitization of development of a producing field but only in the interest of conservation. If he made this determination, applications for approval of a development plan would provide for development of the entire producing field as delineated. Thus, the unit operator would submit one unified plan of development for all unitized leases in that field.

Mandatory unitization could contribute to more efficient development of discovered resources; contribute to optimum placement of collection, storage, and transportation facilities; and would, for purposes of state review and federal review and action, present only one comprehensive development plan for each producing field. Thus, reviewing agencies would be able to view the aggregate situation, including potential cumulative effects of development activities, without the need to review numerous, possibly conflicting plans. In addition, it would provide an overview of area-by-area development in evaluating potential lease operations in the proposed leasing area. The task of reviewing the plan would be less complex in seeking to arrive at a total assessment of the potential onshore and offshore impacts under a plan of development.

A requirement for unitization of development could lead to unitization prior to exploration. Exploration activities on an expected field area would require a joint effort among lessees to minimize exploratory costs prior to unitized development. The requirement for approval of development plans for entire fields could make individual exploration efforts by a lessee economically impractical.

Unitization at the exploration stage would likely result in a slower pace of exploration since the discovery efforts on individual leases would be reduced. In addition, there would likely be a minimum number of exploratory wells and a minimum of geophysical activity. It is likely that, as a consequence of reduction in exploratory activity, some oil or gas fields would remain undiscovered. Exploratory units require a minimum number of wells to be drilled in a given time period. If a discovery of oil and gas does not result and the unit operators do not continue to drill within a specified time interval, the unit would terminate by its own terms. The probable result of this would be that no further exploration activity on the leases in the unit area, and the termination of the leases at the end of their lease term.

Information to be Included in a Plan for Development Under This Alternative

A plan of development under this alternative would probably include more comprehensive information than required at the present time. The plan would have to provide pertinent information, including, but not limited to, the following categories: (1) the number and location of permanent structures or platforms to be installed on a lease; (2) the number and bottom hole locations of wells to be drilled from each platform; (3) the design specifications and major features of each platform, including drilling configuration, production facilities, pollution prevention and control equipment and procedures; (4) proposed pipelines and gathering line routing lines; (5) proposed pipeline and gathering line routing lines; (6) subsurface structure contour maps of expected producing horizons; (7) abnormal pressure maps; (8) information on shallow hazards; (9) anticipated disposition of produced hydrocarbons; (10) proposed location of terminal points, refineries, or gas processing plants, and locations of pipelines that would serve those facilities; (11) proposed location of any other proposed onshore facilities; and (12) an environmental assessment of potential offshore and onshore impacts of the operations described in the plan of development.

The plan of development would provide a general outline of the proposed operations that will be conducted on the lease(s). A federal decision regarding the acceptability of any plan of development would be made only after review and evaluation of the plan by the Geological Survey, and only after consideration and evaluation of comments submitted by the adjacent state during the period provided for state review. Operations which at present require specific federal approval, in addition to approval under a development plan, would continue to require such approvals.

Preparation of Environmental Impact Statements on Requests for Approval of Plans of Development and Conduct of Public Hearings

If it is determined that approval of a plan of development involves a major federal action significantly affecting the quality of the human environment, an environmental impact statement will be prepared in accordance with Section 102(2)(C) of NEPA before taking action on a request for approval of the plan. It is expected that, if the proposed sale is held and this alternative is adopted, some requests for approval of a plan of development would be within the discretion of the Secretary.

Impacts

In summary, the adoption of this alternative would allow a more orderly and comprehensive review of plans of development, particularly with respect to potential nearshore and onshore impacts of the proposed operations in the development phase of OCS lease activities. Adjacent states directly affected by such nearshore and onshore impacts would be provided an opportunity to review and comment on the plans of development, and to register any objections thereto, e.g., where the state is concerned that operations under a proposed plan of development would not be conducted in a safe and environmentally sound manner.

The procedure provided for would allow for better cooperation and coordination between federal and state governments in making potential decisions which bear upon those aspects of potential OCS operations and siting of facilities within the exclusive or concurrent jurisdictions of said governments.

Adoption of this alternative could result in less overall adverse onshore impacts. The mineral potential and location would be better understood at the time a development plan is submitted. This would provide more definitive information on which to base a determination as to the quantities, types, and locations of onshore facilities and transportation networks. Impacts could be evaluated from a specific development plan. This would allow for a level of precision in potential onshore impact assessment not presently possible in pre-sale environmental evaluations. This would be beneficial especially in determining what mitigating measures could be instituted to reduce or eliminate potential nearshore and onshore impacts.

A greater period of delay in securing potential development of OCS oil and gas resources and consequent delay in channeling such production into the domestic supply of energy could occur depending upon the duration of the suspension period. While a period of three months for state review and comment might be provided, it is not possible to predict the additional period of time that might be involved in the evaluation of state comments and potential efforts of the parties to resolve any differences that may arise.

Adoption of this alternative would involve a departure from the existing system of OCS lease supervision in a highly complex area. Because of this, it is not possible to state with any degree of exactness what would be the optimum requirement as to such matters as: (1) time period for review; (2) area to be covered by plans of development; or (3) information to be required under such plans. Consequently, if the Secretary decides to hold the proposed sale and to adopt this alternative, or any variation referred to, he could provide for departmental and state assessment after a stated period afforded for review by the state of California. If modification of the procedures were shown to be necessary, the Secretary could provide for readjustments at that time.

b. Requirement for Separate Information Plan for States

Under this alternative, lessees would be required to provide information to the states in a document separate from the development plan submitted in application for a development permit. The contents of such an information plan would be described in guidelines developed jointly by the Interior Department, the states and the operators. Applicants for development permits would be required to certify that they had provided such information to affected states.

Impacts

This alternative would maintain the integrity of the present permitting responsibility and would avoid the delay and administrative difficulties of establishing a suspension between exploration activities and development. It would provide the states with the information they need to assess the proposed development, and plan their programs while avoiding the difficulties of circulating entire development plans which sometimes include proprietary information. This alternative would not, however, provide a formal opportunity for the states to comment to the Interior Department regarding the development. Of course, informal channels would remain available as they exist presently.

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